Aviation Week and Space Technology

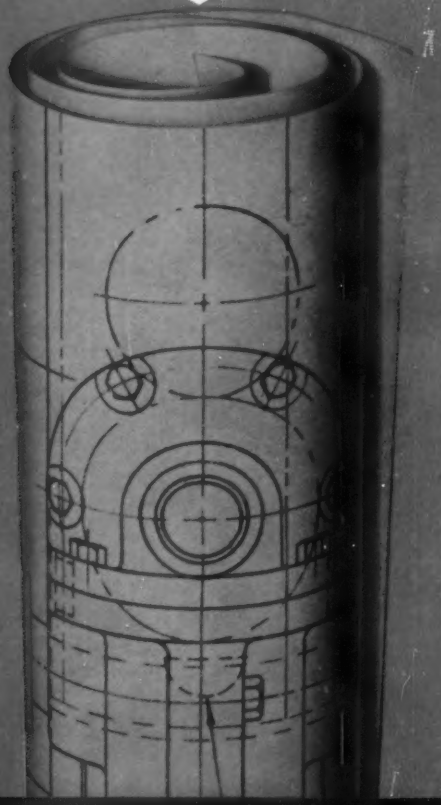
April 11, 1960

SPECIAL REPORT:

J85 Turbojet Design Details

LONG-LOK *self-locking device*

a planned solution to Lock and Anchor fastening problems



Voi-Shan's Long-Lok is a proof-tested, self-locking device designed to resist vibration. This insert can be incorporated into any male-threaded part for use in any medium at temperature ranges from −370°F to +1200°F. Qualified to performance requirements of applicable military specifications, Long-Lok is economical—eliminates the need for lock-washers, safety wires and adhesive staking compounds. It is another example of Voi-Shan's reliable engineering skills. A letter on your company letterhead brings Voi-Shan's technical brochure without charge. Include your application requirements for a specific reply.

VSI

VOI-SHAN MANUFACTURING CO.

A Division of Voi-Shan Industries, Inc.

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"NO ICE TODAY... OR ANY DAY... FOR THIS LADY!

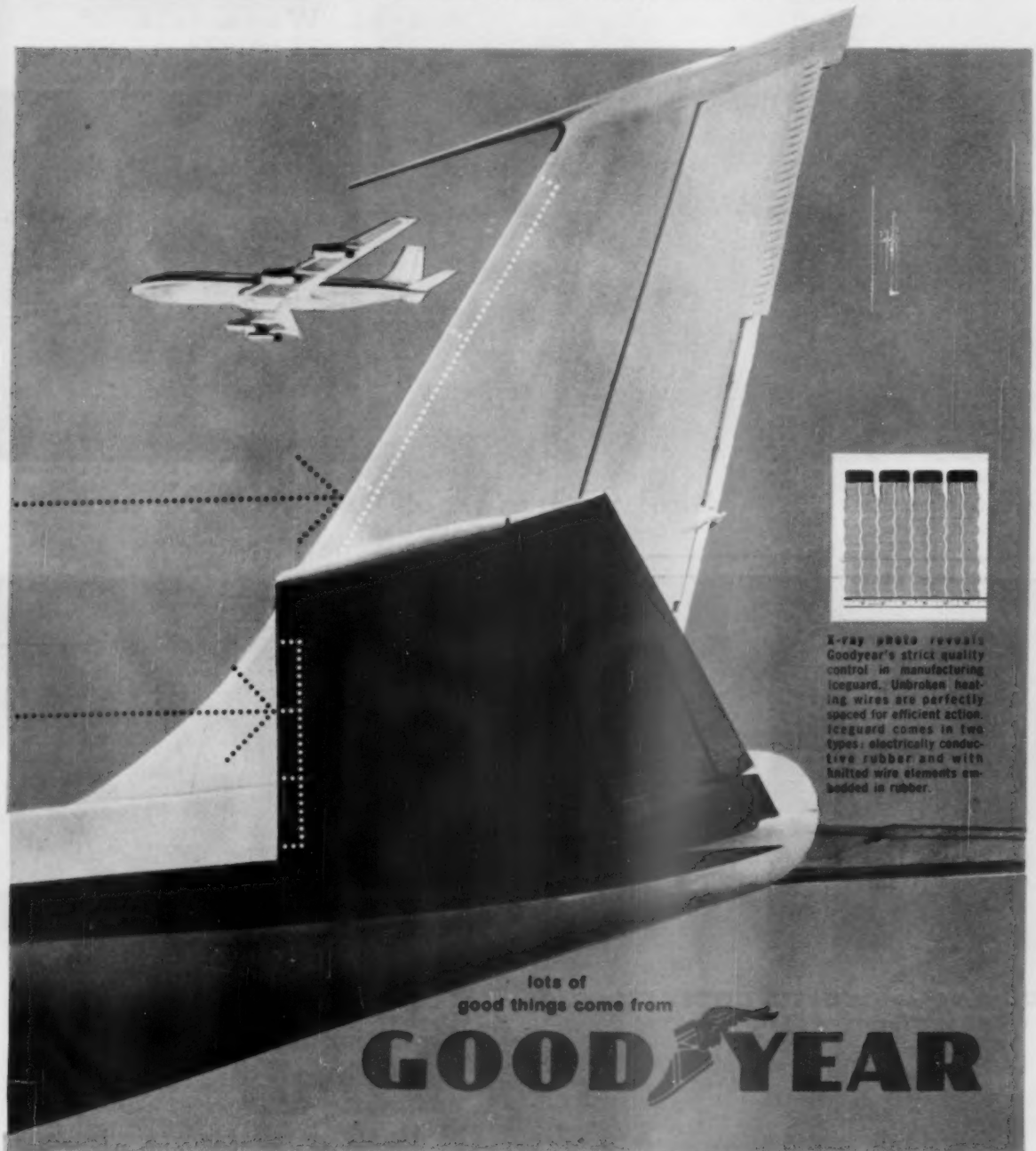
GOODYEAR'S FAMOUS ICEGUARD STOPS ICE *BEFORE* IT FORMS

Iceguard—the precious "ounce of prevention"—scotches icing hazards on the Boeing 707's empennage by efficient *electrothermal* action.

Nine separate Iceguards, tough electrically heated sheaths only "skin" thick, provide positive protection against dangerous ice accumulation. Operating on a fixed cycle at pilot's command, Iceguard heats up at once to shed ice. Goodyear's exclusive knitted heat element distributes heat efficiently to shed ice instantly and reliably.

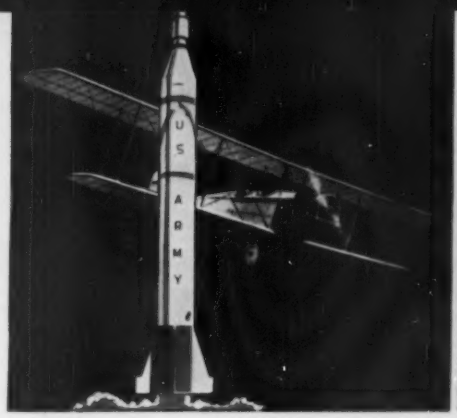
Standard equipment on many of today's all-weather fighters and commercial jetliners, Iceguards are easily tailored to fit any area, any contour—large or small.

Where can *you* use tested and approved Iceguards? They're on the job now for propeller blades and spinners, jet engine intakes, air intake ducts, antennas, wing tips, leading edges—wherever ice-free areas are a must. Write for more facts to The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. P-1715, Akron 16, Ohio.

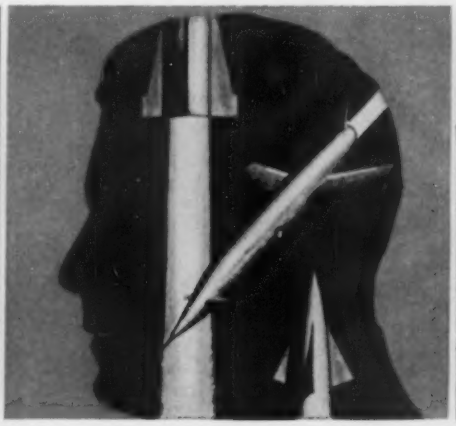

X-ray photo reveals Goodyear's strict quality control in manufacturing Iceguard. Unbroken heating wires are perfectly spaced for efficient action. Iceguard comes in two types: electrically conductive rubber and with knitted wire elements embedded in rubber.
lots of
good things come from
GOODYEAR

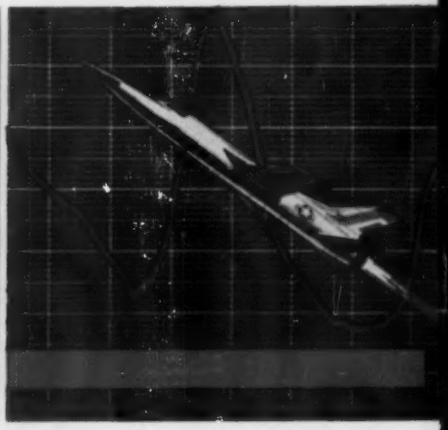
Iceguard – T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

Idea sessions on going places in the sky often put

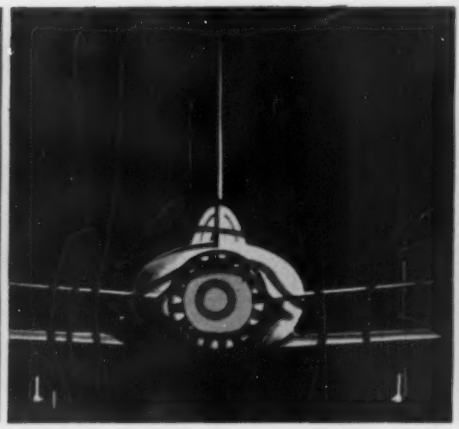


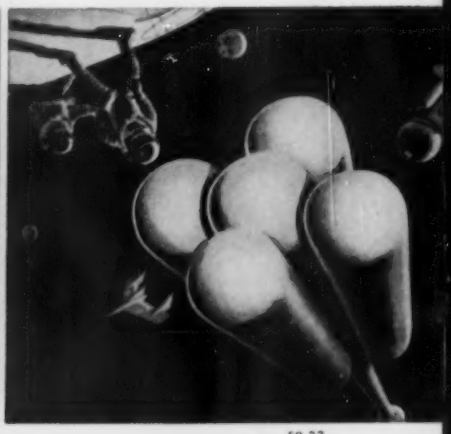
the future as near as the next thought. When talk of





ability turns to availability, think of Ex-Cell-O for the





59-32

pre-requisite to performance...precision.

EX-CELL-O FOR PRECISION XLO

MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O AND ITS SUBSIDIARIES: BRYANT CHUCKING GRINDER CO., CADILLAC GAGE CO., MICHIGAN TOOL CO., SMITH BEARING DIV.

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN
Aircraft Division

AVIATION CALENDAR

Apr. 14—"Pioneering in Aircraft," the Second Annual Lester D. Gardner Lecture, to be delivered by Dr. Igor Sikorsky, Massachusetts Institute of Technology, Cambridge, Mass.

Apr. 19-21—International Symposium on Active Networks and Feedback Systems, New York, N. Y. Sponsors: Polytechnic Institute of Brooklyn; Department of Defense Research Agencies; Institute of Radio Engineers.

Apr. 19-21—10th Annual Convention, International Airline Navigators Council, Hotel Manhattan, New York, N. Y.

Apr. 20-22 — National Symposium on Manned Space Stations, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif. Cosponsors: NASA; the Rand Corp.

Apr. 21—Annual Eastern Regional Meeting, Institute of Navigation, Key Bridge Marriott Motor Hotel, Washington, D. C.

Apr. 21-22—Southwest Metals & Minerals Conference "Metals and Materials for the Space Age," American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Apr. 21-22—Seventh Annual Heat Transfer Conference, "A Survey of Radiation Phenomena and Heat Transfer Equipment for Space Flight Application," Oklahoma State University, Stillwater, Okla.

Apr. 27-28—National Meeting on Space Age Materials, Cincinnati Chapter of the American Society for Metals, Sheraton Gibson Hotel, Cincinnati, Ohio.

Apr. 28-29—18th Annual Meeting, Aeronautical Training Society, Mayflower Hotel, Washington, D. C.

Apr. 28-29—Regional Quarterly Meeting, Assn. of Local Transport Airlines, Warwick Hotel, Philadelphia, Pa.

Apr. 28-29—Symposium on "Closed Circuit Respiratory Systems," Wright Air Development Division, Wright-Patterson AFB.

(Continued on page 6)

AVIATION WEEK and Space Technology

April 11, 1960

Vol. 72, No. 15

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Offices, 99-129 North Broadway, Albany 1, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Joseph A. Gerardi, Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary.

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As an alternative to a permanently wired system, Lisle Chip Detectors can be ground checked with a continuity tester.

LISLE *Write for Catalog and Samples for Testing*

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AVIATION CALENDAR

(*Continued from page 5*)

May 1-4—1960 Annual Meeting and News Conference, Aviation Writers Assn., Los Angeles, Calif.

May 2-4—National Aeronautical Electronics Conference, Biltmore and Miami-Pick Hotels, Dayton, Ohio. Sponsor: Institute of Radio Engineers.

May 2-5—Sixth National Flight Test Symposium, Instrument Society of America, San Diego, Calif.

May 4-6—"Properties and Application of Materials in Aerospace Vehicle Design," Symposium, Park Lane Hotel, Denver, Colo. Sponsor: The Martin Co., Denver.

May 9-11—31st Annual Meeting, Aerospace Medical Assn., Americana Hotel, Bal Harbour, Miami Beach, Fla.

May 9-11—1960 Symposium of the Institute of Radio Engineers' Professional Group on Microwave Theory and Techniques, Hotel del Coronado, San Diego.

May 9-12—Semi-Annual Meeting and Astronautical Exposition, American Rocket Society, Ambassador Hotel, Los Angeles.

May 9-13—Second Southwestern Metal Congress and Exposition, American Society for Metals, Sheraton Dallas Hotel and State Fair Park, Dallas, Tex.

May 9-13—Annual Conference, Society of Photographic Scientists and Engineers, Miramar Hotel, Los Angeles, Calif.

May 10-12—1960 Electronic Components Conference, Willard Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers' Professional Group on Component Parts; American Institute of Electrical Engineers; Electronic Industries Assn.; Western Electronic Manufacturers Assn.

May 11-14—16th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 15-18—Annual Convention and Business Meeting, American Assn. of Airport Executives, Waldorf-Astoria, New York.

May 16-20—Aviation Fire Safety Seminar, National Fire Protection Assn., Queen Elizabeth Hotel, Montreal, Canada.

May 18-20—National Meeting, Society for Experimental Stress Analysis, Hotel Severin, Indianapolis, Ind. Theme: Stress Analysis of Propulsion Systems.

May 22-29—Fourth Annual Reserve Navigation Competition, Ellington AFB., Tex.

May 23-25—12th Annual Meeting, German Society for Rocket Engineering and Space Flight Research, Heidelberg, Germany.

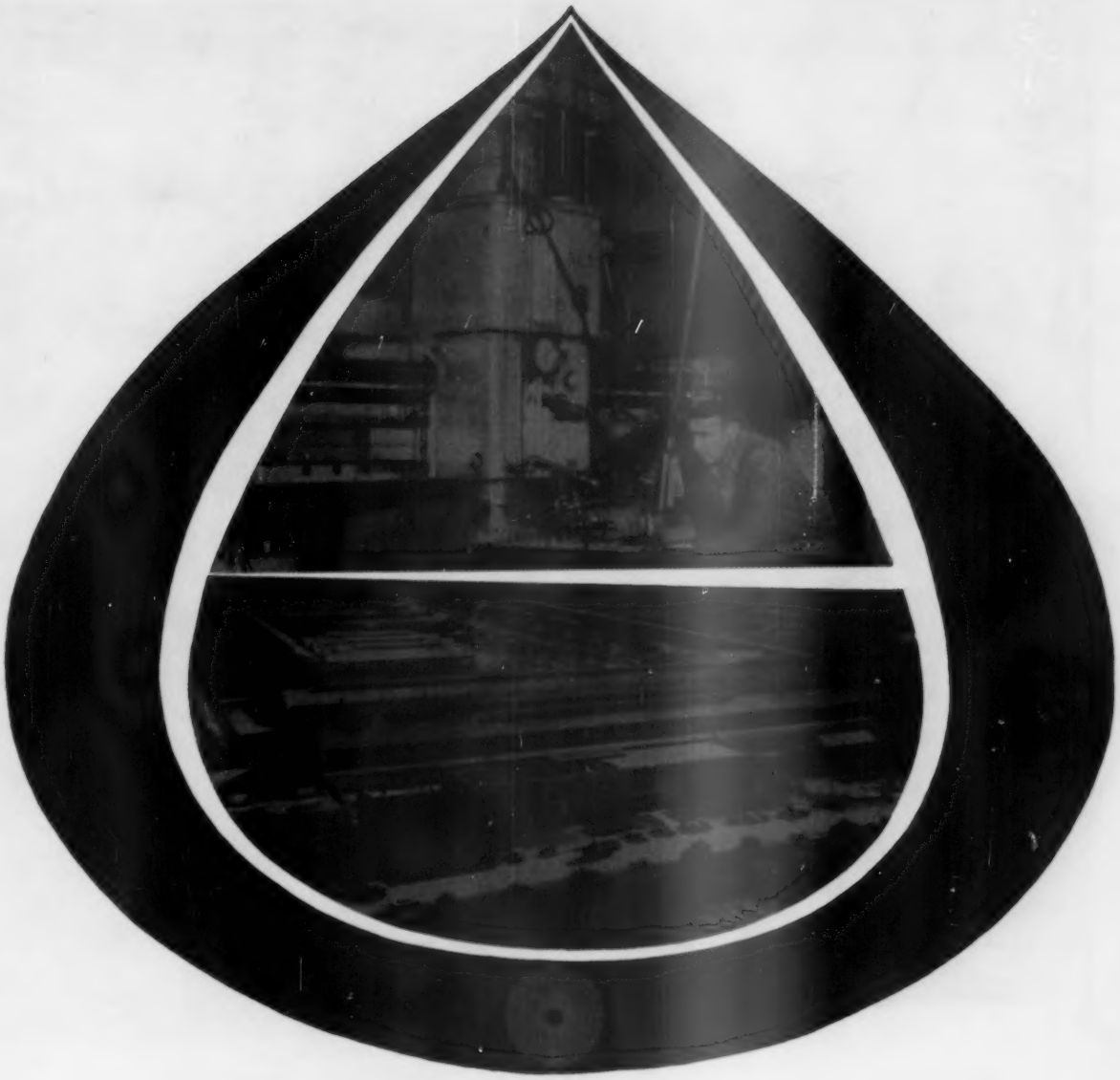
May 24-26—1960 Convention, American Society for Quality Control, San Francisco, Calif.

May 26-27—"Psychophysiological Aspects of Space Flight" Symposium, Hilton Hotel, San Antonio, Tex. Sponsored by the School of Aviation Medicine, USAF Aerospace Medical Center (ATC), and arranged by Southwest Research Institute. Unclassified, but by invitation.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 12-16—16th Annual General Meeting, International Air Transport Assn., Copenhagen, Denmark.



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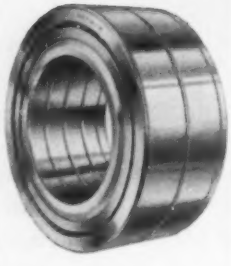
From left, Pratt and Whitney Aircraft's J-57, J-52, JT-12, and J-75, jet engines.



This typical Fafnir jet engine bearing is fabricated of specially processed alloy steels, the cleanest available. It is an angular contact type bearing with intricate split inner ring. All components are precisely fitted. Balls and raceways are precision-finished to millionths of an inch.

Fafnir main rotor bearings help carry the load in these Pratt & Whitney Aircraft jet engines!

In a jet engine, the only parts that "anchor" the massive main rotor are the bearings on which the rotor shaft rides. Fafnir is a major supplier of the main rotor thrust bearings that handle this critical assignment in Pratt & Whitney Aircraft jet engines.

Few applications put such a premium on unfailing performance . . . and few involve such operational extremes. The bearing has to support thousands of pounds of thrust load from the rotating parts of the engine, in addition to extremely heavy radial loads under maneuver conditions. They must not only carry these loads but also maintain precise positioning of the rotating parts at 10,000 to 15,000 R.P.M. speeds.

To insure the reliability necessary in this service, Fafnir and Pratt & Whitney Aircraft joined engineering talents to design the rotors for each rotor application. The bearings are practically flawless in every detail of materials and workmanship. The capabilities that produce these "bearing masterpieces" are also available to you. You can rely on Fafnir to meet your most exacting jet engine, accessory, or control bearing needs. Write The Fafnir Bearing Company, New Britain, Conn.

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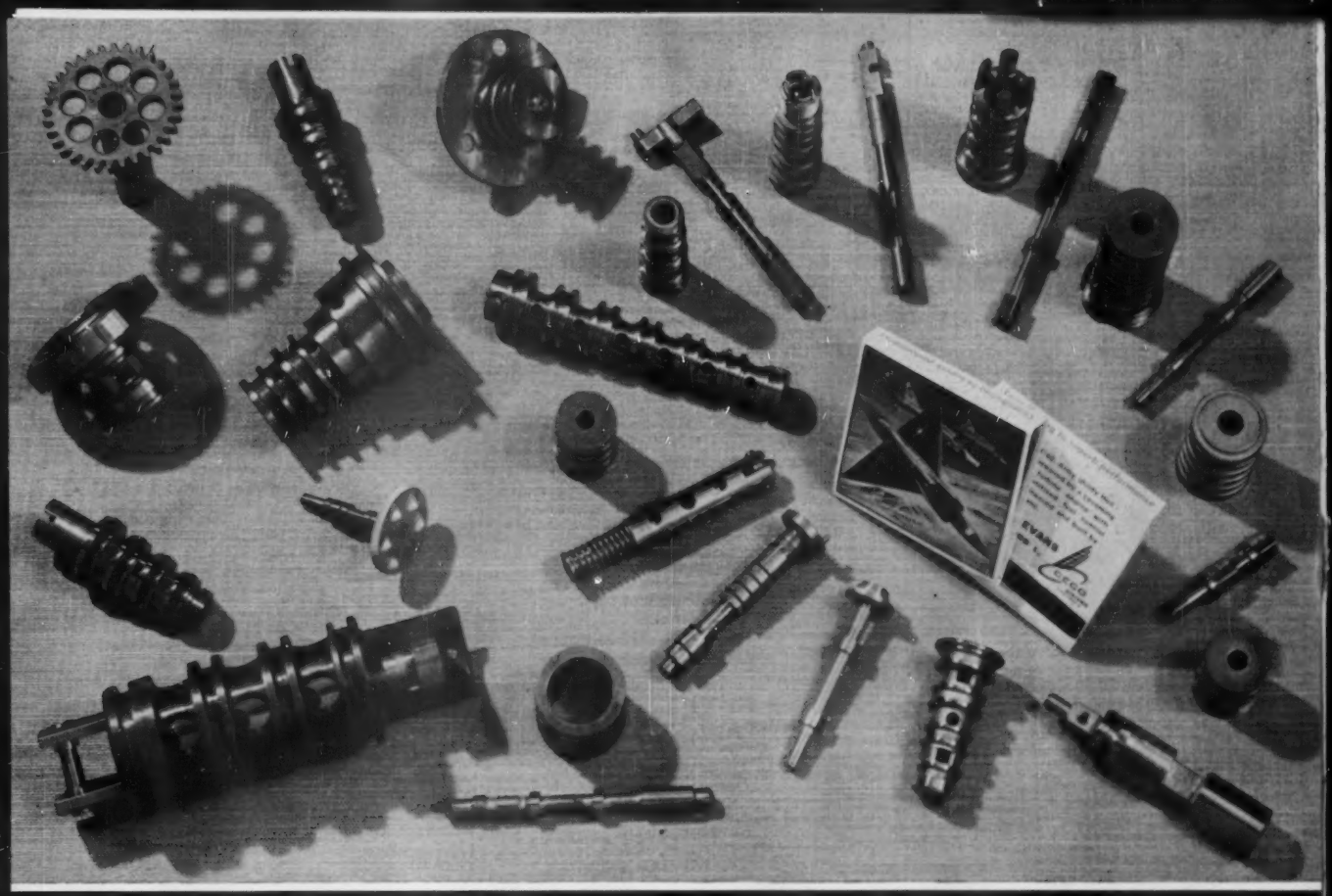
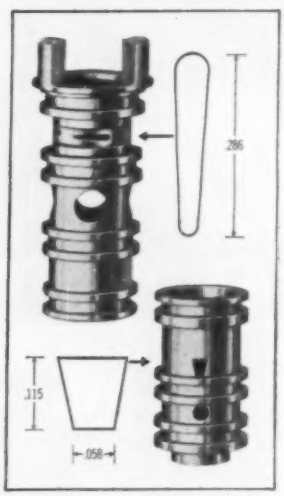
See the Ratiometer demonstrated at the **ISA FLIGHT TEST SYMPOSIUM**, suite 180-181, Hotel del Coronado, San Diego, Calif., May 2-5



Looking for a subcontractor with real servo "savvy"?

. . . THEN TAKE A GOOD CLOSE LOOK AT THE SERVO COMPONENTS DISPLAYED HERE



As a subcontractor, CECO is equipped to handle specifications demanding production tolerances to 5 millionths of an inch and finishes to .5 RMS. Most of the servomechanism system components shown above were manufactured to just such specifications.

High-precision square holes? Other unusual porting requirements? Assignments like these are considered routine in Chandler Evans subcontract operations.

Among the "tools" of CECO's servo trade are Cavitrons, ultra-sonic cleaning devices and temperature-controlled, contamination-free assembly areas.

Components, assemblies and complete subsystems can be fabricated with equal facility.

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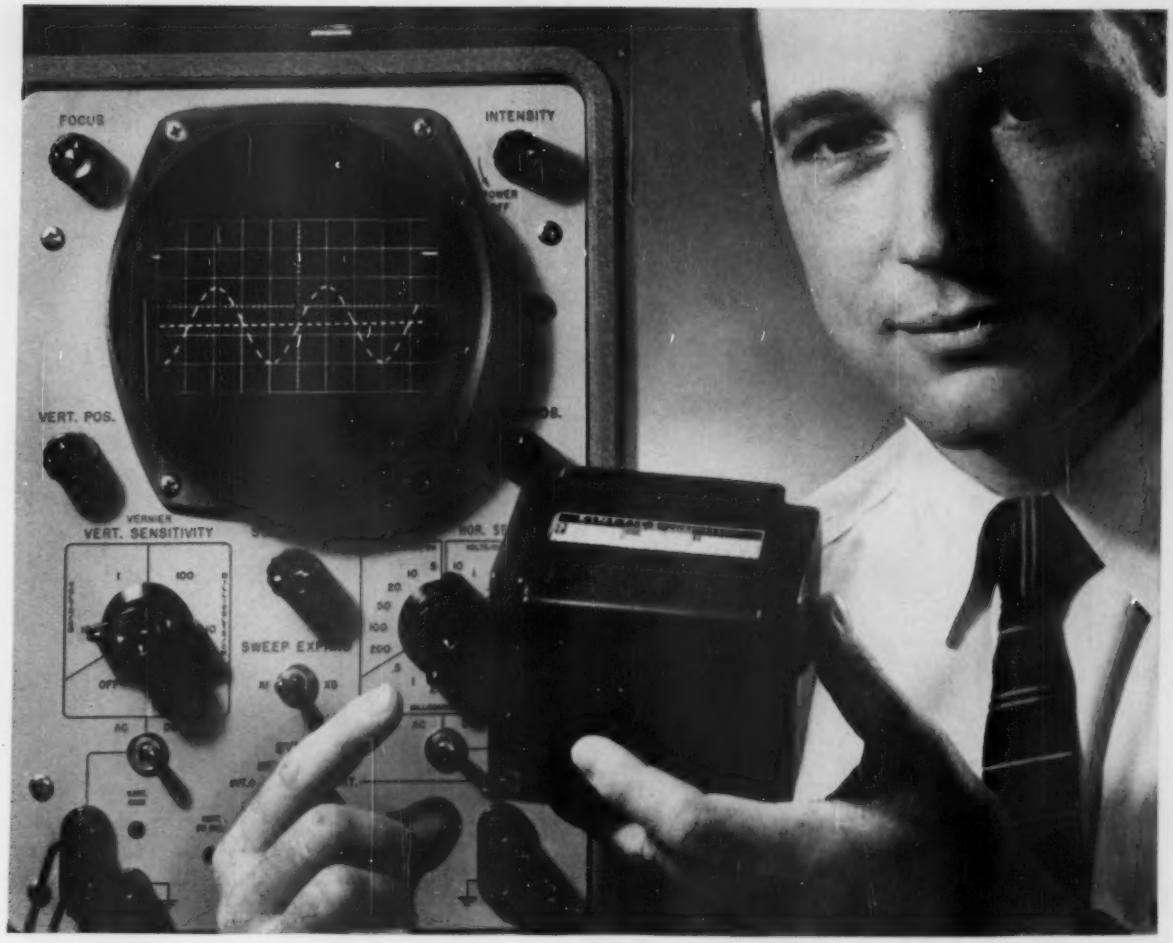
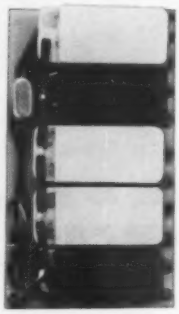
"WHERE THERE'S PROGRESS, THERE'S PLEXIGLAS"



Kinetics electronic commutator offers greater accuracy and over 10,000 hrs. life



The Kinetics electronic commutator features modular construction, achieving maximum space utilization and easy application to various configurations.

As shown by the pattern on the scope, the new electronic commutator now available from Kinetics Corporation offers a high degree of commutation fidelity. Note the extremely short rise and fall times with no apparent deterioration of signal. Faithful reproduction such as this will continue through a forecast life of 10,000 hours or more. This commutator is recommended for all aircraft and missile multiplex telemetering systems where accuracy and long life are required.

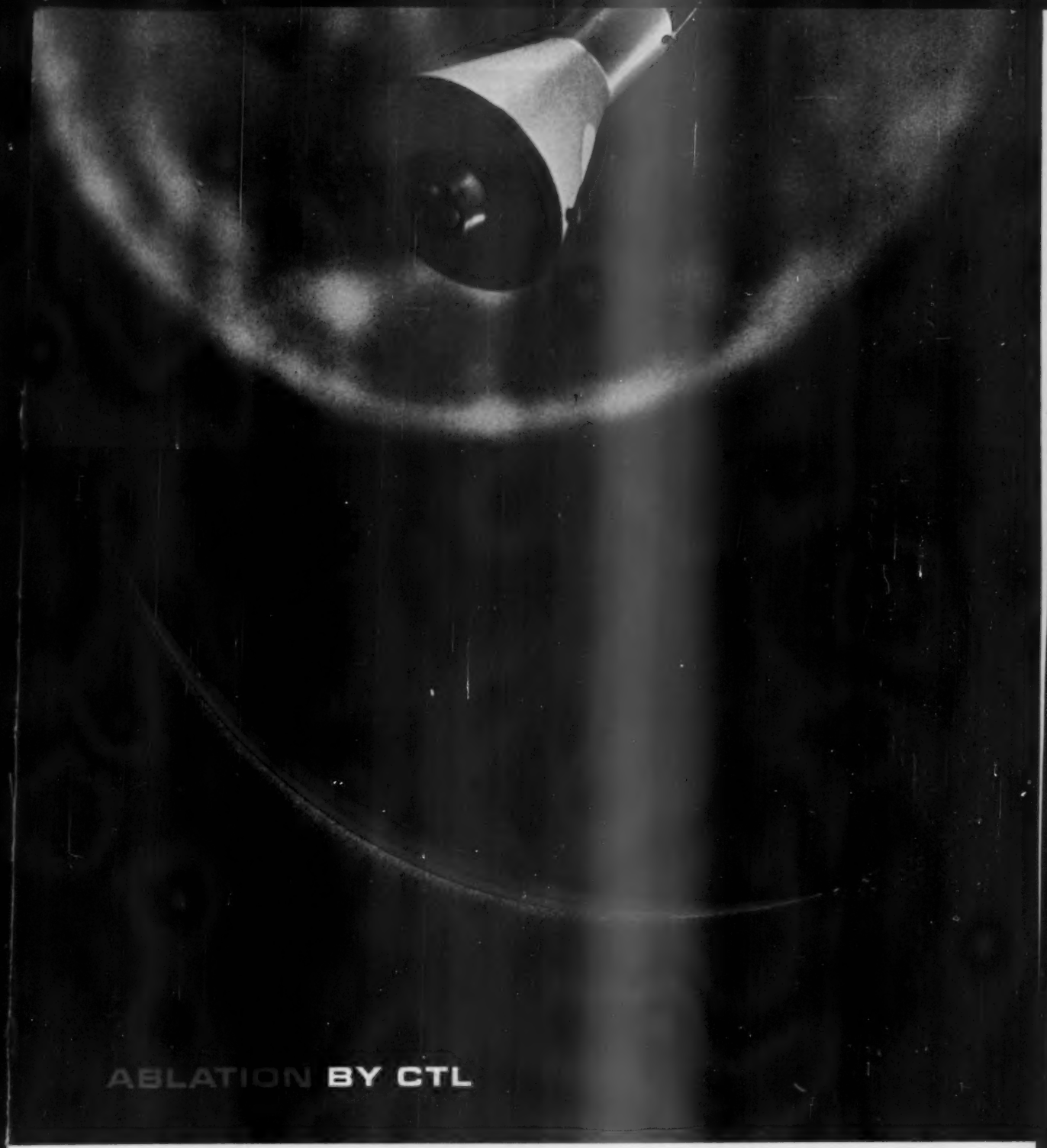
There are no built-in amplifiers to affect the signal in the straight-forward Kinetics design. This is a solid state unit—semi-conductor components are used throughout. Operating temperature limits are from $-60°C.$ to $125°C.$ Load resistance of the Kinetics design ranges from 5000 ohms to 2.5 megohms.

This commutator offers excellent low level capability, down in the low millivolt range. Contact resistance is low, from 5 to 10 ohms. Leakage currents are less than .005 microamperes at 5-volt signal levels. Extremely compact construction has been achieved, averaging only .4 to .5 cubic inches per channel, decreasing as channels are added. Power consumption is low. Sampling rates up to 50,000 samples per second are possible.

Write for more information on this electronic commutator. Kinetics Corp., Dept. K 21, 410 South Cedros Avenue, Solana Beach, Calif. SKyline 5-1181.

KINETICS
CORPORATION

ELECTRONICS · ELECTROMECHANICS



Heat dissipation by the gradual and controlled separation of matter—an area of intense research at CTL for several years. If heat flux on any surface in your design ranges from 50 btu/ft² sec to 50,000 btu/ft² sec, benefit from CTL's work with reinforced plastic fabrications. Development of high temperature resins plus sophisticated reinforcement fiber orientation has made it possible for CTL to provide effective, low-weight fabrication —expansion cones of Minuteman, the nose of the Jupiter, the face of the Mercury. Find out how CTL can assist with your heat insulation problems. Request Bulletin 160.

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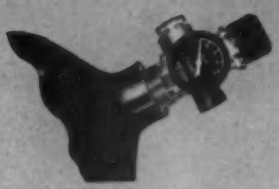
Scott Emergency Oxygen System drops masks to passengers in event of decompression or cabin pressure loss.

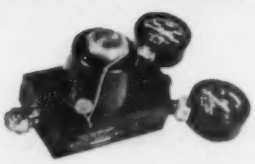
Scott 10500 Automatic Turn-On Valve. Activates passenger oxygen system when cabin pressure drops.



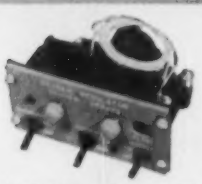
Scott 10850 Slow Opening Cylinder Valve. Protects against high pressure surge.

Scottoramic Mask. Provides unlimited vision. Gives respiratory and eye protection in smoke and fume emergencies.

Scott 5600 Portable, Dual Purpose Oxygen Unit. Provides demand and constant flow. Serves passengers and crew.



Scott 10260 Reducing Regulator. Reduces cylinder pressure to system working line pressures. Highest capacity. Lightest weight.



Scott 10400 Diluter Demand Miniature Panel Regulator. Supplies all crew oxygen requirements for jet transport operation.

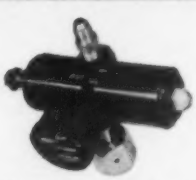
Scott Aviox. Portable oxygen equipment for four. Complete in quality leather case.

Scott Oxygen Console. Fixed type. Supplies oxygen to from one to five persons.

Scott "President" Oxygen Installation Kit. Complete equipment for from one to five persons.

Scott "Executive" Oxygen System. Portable, lightweight unit. Serves one to two persons.

Scott Jet-Set. Fast donning mask suspension device. Provides immediate respiratory protection up to 45,000 feet with demand or pressure demand oxygen equipment.



Scott 5425 Variable Oxygen Line Pressure Regulator. Reduces oxygen cylinder pressure to a lower pressure in linear relationship.

OTHER SCOTT PRODUCTS

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- Control Wheels
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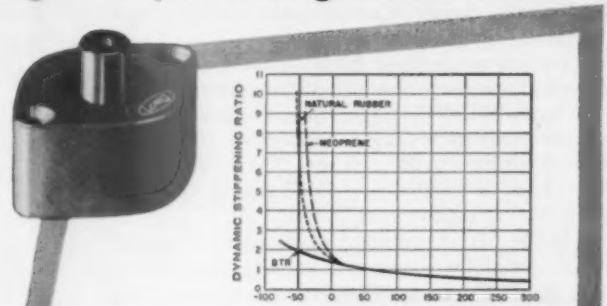

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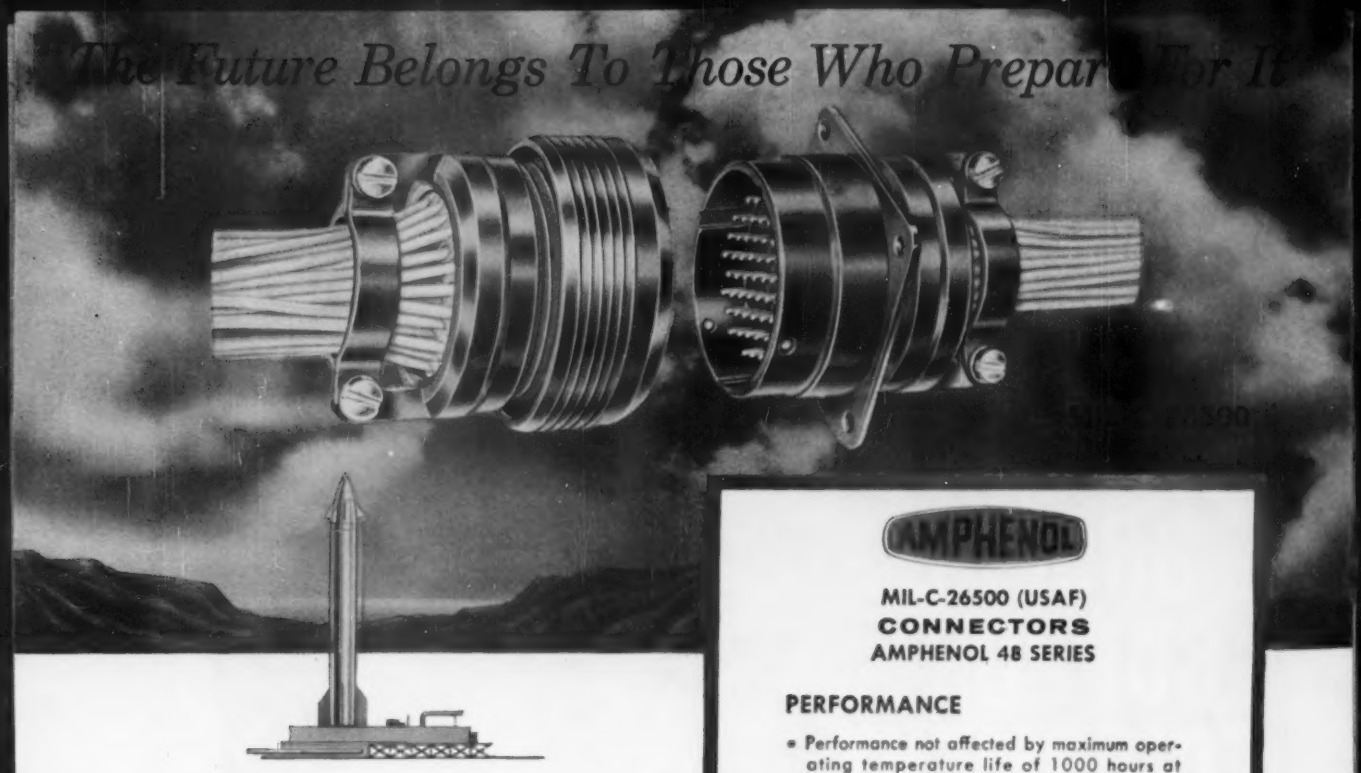

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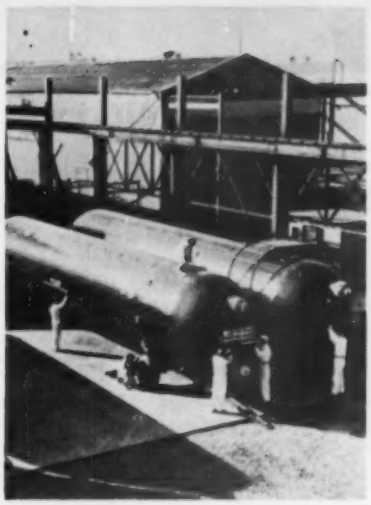

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Aviation Week and Space Technology

Vol. 72, No. 15
Member ABP and ABC

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COVER: Latest step in evolution of intercontinental ballistic missile re-entry vehicles is Avco's RVX-4, prototype of operational Mk. IV nose cone, shown just before it made its first flight on USAF-Convair Atlas 44-D from Air Force Missile Test Center's Florida launch complex. Originally programed only for USAF-Martin Titan, the Mk. IV, with increased explosive yield over earlier warheads, now will appear on both Atlas and Titan. RVX-4 tests Avco ablative materials at same speeds and simulated weights as re-entering warheads will encounter. See pictures on p. 91.

PICTURE CREDITS

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When crews of SAC's 1st Missile Division successfully launched the USAF ICBM Atlas from Vandenberg Air Force Base, September 9, 1959, the world became aware that the United States had brought into being a formidable retaliatory power for peace. Within four months after the first operational launch, the Air Force doubly underlined this missile's capability. On a single day, January 26, 1960, the 16th and 17th consecutive successful Atlases were fired intercontinental ranges to predetermined targets from both Atlantic and Pacific bases.

After only five years of intensive development, including concurrent research, testing and fabrication under this nation's top military priority, Atlas is extremely versatile as well as powerful. It was the Project Score satellite vehicle and is scheduled for use in Project Mercury, the Man in Space Program, and in other space exploration missions. Thus, used as a booster for space projects, Atlas provides the nation with a key capability in scientific as well as military applications.

Space Technology Laboratories provides the systems engineering and technical direction for the Atlas as well as other portions of the Air Force Ballistic Missile Program. Much of what was learned in building Atlas has helped cut the lead-time in the development of such other Air Force Ballistic Missiles as Thor, Titan and Minuteman.

Among the industrial organizations which have worked in concert in developing Atlas are such major contractors as: Convair, Division of General Dynamics Corp. for airframe, assembly and test; General Electric Co. and Burroughs Corp. for radio guidance; Arma, Division of American Bosch and Arma Corp. for inertial guidance; Rocketdyne Division of North American Aviation, Inc., for propulsion; General Electric Co. for re-entry vehicle; Acoustica Associates for propellant utilization.

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The continuing development of Atlas as well as other USAF missiles and related space probes, has created important positions on STL's technical staff for scientists and engineers with outstanding capabilities in: thermodynamics, aerodynamics, electronics, propulsion systems, structures, physics, computer technology, telemetry, and instrumentation. If you believe you can contribute in these or related fields and disciplines, you are invited to send your resume to:

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EDITORIAL

Space Program Turns a Corner

The successful operations of the Pioneer V deep space probe and the Tiros weather-eye satellite during the past few weeks may indicate a significant upturn for the U. S. space program as currently operated by the National Aeronautics and Space Administration. Both of these space shots were executed with technical precision that placed their payloads in their anticipated positions in space. Both payloads have been functioning with a high degree of reliability and returning a significant amount of useful scientific data to earth. The almost perfect circular orbit of Tiros is another major advance.

These successful space ventures are also significant because they prove a point many people made in the early days of the Sputnik era. This was that this country has the technical capability to mount a scientifically significant and internationally useful space exploration program and that the only essential ingredient lacking was national leadership and organization.

All of the hardware utilized in both Pioneer V and Tiros came from groups long established in the aerospace industry: Radio Corp. of America, Space Technology Laboratories, Douglas Aircraft, North American Aviation, Aerojet, Hercules Powder Co. and several universities. Launchings were handled by the USAF Ballistic Missile Division which has managed the ballistic missile program so expeditiously. NASA, of course, served as the over-all systems manager for both of these projects.

There are some notable differences between Pioneer V and Tiros, on the one hand, and the Soviet lunar ventures of last fall. The Soviets have still not furnished much useful scientific data from these lunar ventures despite the successful execution of both the impact and satellite missions. Nor have the Soviets, for all their lip service to scientific interchange, made much tangible contribution to this cause. This may be because the data returned from their impressive list of successful space vehicles is meager and they might be internationally embarrassed by this exposure or it may be simply another manifestation of the centuries-old Russian passion for secrecy in conflict with its modern environment.

However, both Pioneer V and Tiros are already firmly established by their performance in space as scientifically useful ventures. This significance is expanding with each passing day of their performance. Pioneer V, among other things, has proved the feasibility of long-range communications in outer space and has given a remarkable demonstration of the reliable use of solar energy in this area. Tiros, providing its global cloud cover strips, certainly must have an impact on some of the early skeptics who refused to believe that anything really useful to man on earth could come from "this space nonsense." Tiros is the first of the initial generation of useful satellite programs whose benefit will soon be available.

On the basis of the data made available by NASA on its variety of space programs, particularly Pioneer V and Tiros, compared with what the Soviets have made public on their efforts, it appears that we have begun to produce more scientifically useful space efforts than the Soviets, although it will be a long time before the international propaganda lustre is worn from their initial successes.

It would be a mistake to conclude that Pioneer V and Tiros, have in themselves won the space race with the Soviets and that we can now relax and coast along comfortably. It is obvious that the Soviets have more tricks to pull from their space bag. With the decay of Sputnik III it is not likely that they will leave space bare of devices bearing the "CCCP" label of their Cyrillic alphabet. It takes no special crystal ball to predict that the next Soviet space efforts will be timed to obtain maximum political effect from the Summit meetings in May and President Eisenhower's visit to the USSR in June.

Thus far, the Soviet space scientists have loftily rejected U. S. proposals to establish an International Academy of Space Sciences (AW Mar. 28, p. 25) as "premature." This attitude is apparently stimulated by the Soviet feeling that they are the primary fount of space science and little contributions are available now from other countries. Dr. Theodore von Karman, one of the authors of the international proposal, has wisely observed that this Soviet intransigence is likely to melt "once we have a few successes." It will be interesting to watch the Soviet attitude toward the international academy proposal as a possible barometer of their own space technology and an indication of when they feel they may have something to gain from an international scientific exchange.

One other aspect of the Soviet space program, in contrast with our own, that emerges with the passing of time is the surprising lack of depth and scope to their effort. They have conducted no satellite launchings since Sputnik III on May 15, 1958. In the interval, they have mounted only three lunar missions. This is ample for an international propaganda program but can hardly fill the requirements of a serious space exploration program.

In contrast, both the NASA and USAF space programs are now moving on an extremely broad front covering the entire spectrum of immediately feasible space exploration projects and aimed at providing immediately useful results from space such as long-range communications, reconnaissance, weather information and precise navigation fixes.

Thus, as we pass the half-way mark of the third year of the space era, we can see some significant changes developing in our position versus that of the Soviets.

There is general agreement that NASA has developed a sound 10-year program for the scientific exploration of space and the military services keenly appreciate the potential of space systems to deter aggression and blunt the edge of enemy surprise.

The problem now is to stick to the objectives detailed in the NASA program and to push their achievement with the full budgeting and technical support they require.

We are certainly in a bitter international contest with the USSR for the minds of men, and space is an important sector in that battle. But, regardless of this important aspect of our space program, there are many other valid reasons for pressing on at a maximum technical pace to reap for ourselves and the rest of mankind the immediate benefits available in space and to provide more knowledge of the universe around us that is the truly distinguishing mark of man himself.

—Robert Hotz

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CAI's specialty: reconnaissance and surveillance from conception through finished hardware. Pacific Optical Corporation Division assures comprehensive internal control and production for fast starts and crash programs. CAI now ranks as the only visual sensor system manufacturer with complete lens system design and fabrication facilities! Whatever the optronic project, CAI stands as best equipped to handle it . . . quickly, efficiently, creatively, reliably.

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In the Front Office

Maj. Gen. Victor E. Bertrandias (USAF, ret.), a director, Transval Electronics Corp., El Segundo, Calif.

G. F. H. Hemsley, a director, Vickers Armstrongs (Aircraft), Ltd., Weybridge, England. Mr. Hemsley continues as chief engineer-aircraft.

Charles H. Sommer, president, Monsanto Chemical Co., St. Louis, Mo., succeeding **Charles Allen Thomas**, now chairman.

W. M. Turner, president, Astrometrics, Inc., Santa Barbara, Calif., newly formed division of Arnoux Corp.

Paul S. Heflin, vice president-engineering, Semiconductor Division of General Instrument Corp., Newark, N. J.

Robert L. Earle, executive vice president, Pacific Airmotive Corp., Burbank, Calif.

Varian Associates, Palo Alto, Calif., has named the following as vice presidents: **Paul B. Hunter**, Patent Department; **Dr. Theodore Moreno**, Tube Division; **Dr. Emery H. Rogers**, Instrument Division.

George Lewis, vice president-operations, and **Phil Hobbes**, vice president-product engineering, Aero-Flex Corp., San Diego, Calif.

Richard M. Johnson, a vice president of the New Britain Machine Co., New Britain, Conn. Mr. Johnson continues as president of Koehler Aircraft Products Co., a New Britain subsidiary.

Kenneth H. Jacobs and **G. Daniel Brewer**, assistant vice presidents, Grand Central Rocket Co., Redlands, Calif.

Warren R. Winn, Jr., assistant to the president, Eastern Air Lines, Inc.

Maj. Gen. Marcus F. Cooper, deputy chief of staff of research and engineering, Air Research and Development Command, Andrews AFB, Washington, D. C. **Brig. Gen. Paul T. Preuss** succeeds Gen. Cooper as assistant administrator of the Federal Aviation Agency's Office of Plans and Requirements, Washington, D. C.

Honors and Elections

Rep. Oren Harris (D.-Ark.), chairman of the House Interstate and Foreign Commerce Committee and the House Legislative Oversight Committee, has received the Air Freight Forwarders Assn. 1960 Public Service Award as Legislative Man-of-the-Year.

Kenneth A. Norton, Chief of the Radio Propagation Engineering Division at the Boulder, Colo., Laboratories of the National Bureau of Standards, has received the 1960 Harry Diamond Memorial Award of the Institute of Radio Engineers for "contributions to the understanding of radio wave propagation."

Changes

Marion F. Thorne, assistant to Dr. Simon Ramo, Thompson Ramo Wooldridge, Inc., Canoga Park, Calif. Mr. Thorne continues as director of executive staff services for the Ramo-Wooldridge Division.

Capt. Sheldon Brown (USN, ret.), assistant manager, Aerojet-General Corp.'s Atlantic Division, Frederick, Md.

(*Continued on page 136*)

INDUSTRY OBSERVER

► At least a dozen companies are expected to submit proposals for a geodetic satellite to National Aeronautics and Space Administration by mid-April. NASA is asking for delivery of satellite in 15 months. Total of 18 companies attended recent NASA bidders' briefing session. Satellite will be equipped with solar-powered flashing lights that can be photographed against a stellar background to establish geodetic relations and distances (AW Mar. 28, p. 29). Bids are expected to close Apr. 18 but may be extended.

► **Martin Co. is preparing a proposal for a 1,000-mi. version of the Pershing tactical missile. Missile would have a longer first stage using the present propellant grain. Second stage would be the same as that used for the present Pershing. All but three inches of lengthened first stage would be compensated for by compressing the instrument section. Missile would weigh approximately 13,000 lb. as compared with 28,000 lb. for Polaris and reportedly could use most of the Pershing support equipment.**

► Air Force is considering development of an ICBM-type liquid rocket engine based upon a thrust potential of 250,000 lb. for each booster barrel. Possible configurations include a combination of three boosters to form a complete 750,000-lb.-thrust package or two boosters and a sustainer as in the present Atlas MA-3 Rocketdyne engine (see p. 76).

► **Air Materiel Command has asked suppliers of equipment for the Republic F-105 to submit budgetary estimates for the following number of aircraft in addition to the 220 funded for Fiscal 1960—308 in Fiscal 1961, 336 in Fiscal 1962, 336 in Fiscal 1963 and 225 in Fiscal 1964.**

► Mitre Corp. will expand its operations beyond present air defense problems to include Air Force electronic support systems following a recent USAF proposal to cut back on Bomarc-B and SAGE super-combat center program (AW Apr. 4, p. 29). Mitre Corp. already is playing a prominent role in USAF's "Winter Study" of the coming decade's requirements for electronic support systems (AW Mar. 7, p. 219).

► **Another change in Advanced Research Projects Agency military communications satellite program will be proposed for Joint Chiefs of Staff approval within the near future. Project Steer, the repeater-type polar-orbit satellite intended for use by Strategic Air Command, may be dropped to permit acceleration of Project Decree, the 24-hr. hovering communications satellite. The former was being developed under Air Force cognizance, the latter by Army. Earlier, ARPA dropped plans for Project Tackle intended to test components for the hovering communications satellite (AW Feb. 8, p. 23).**

► Wyandotte Chemical Corp. has developed a new high energy monopropellant under Navy contract. Called Cavea B, the propellant is believed to have a theoretical specific impulse approaching 260 sec.

► **Timetable for Avro Canada's "flying saucer" project is being slowed by stability difficulties and a reduction in the anticipated thrust. Continuing USAF support of the project is doubtful, but the Canadian government may fund the flight-test phase to the extent of approximately $2 million.**

► Martin Co., which now holds 17% of the common stock of General Precision Equipment Corp., is expected to seek representation on the firm's board of directors at GPE's annual meeting to be held later this month. The action is viewed as the first step toward a possible merger between the two companies.

► **Boeing Airplane Co. is studying possible methods of deploying Air Force's Minuteman solid-propellant ballistic missile at sea to increase the system's over-all mobility. Study has the backing of Lt. Gen. Bernard Schriever, commander of USAF's Air Research and Development Command, and Rear Adm. J. T. Hayward, deputy chief of naval operations for development. Navy, however, says it can develop its proposed 2,500-mi.-range version of the Polaris well before Minuteman could be adapted to an ocean environment.**

HOW THE SILICONES MAN HELPED...

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Washington Roundup

Mercury Clamp-Down

National Aeronautics and Space Administration is holding down its publicity effort on the Mercury man-in-space program. The hold-down is a response both to congressional criticism and to internal philosophy. Space Task Group officials and the seven Mercury pilots join many headquarters officials who feel too much is being said before any major Mercury goals have been achieved.

NASA is highly sensitive to congressional criticism, and the main impetus for the current hold-down has come from critics on Capitol Hill. Critics tend to overlook the fact that much Mercury publicity is simply a response to strong public interest in the program.

Astronauts also feel they have had too much of the spotlight with too little credit going to the technical and administrative force putting the program together. They also feel the safety angle is oversold. They fear the program will be retarded by undue emphasis on safety for publicity reasons.

Merger Speculation

Slick Airways-Seaboard and Western merger talks may provide CAB with an opportunity to demonstrate its reported willingness to approve airline mergers as a means of strengthening the industry. Slick hasn't flown its domestic routes for two years, but it has an attractive tax loss to offer Seaboard and Western. Both carriers have ordered the Canadair CL-44.

Merger would restore competition on transcontinental cargo routes and form the first U.S. domestic-international cargo line. CAB has pushed airline competition in recent years. Slick's return to service would provide competition on the transcontinental routes Flying Tiger Line now operates as a profitable all-cargo monopoly. Merger undoubtedly would be protested by the Flying Tiger Line and other carriers.

CAB will have to decide whether it wants to strengthen airlines by strengthening their route structures or by permitting them to merge. The Board has used the new route approach for five years. There are now signs CAB may permit mergers in order to build fewer, stronger competitors.

Congress Views Subsidy

Congressional displeasure with airline subsidies will work against Capital Airlines' attempt to regain subsidy status. CAB would need more than the requested $69 million subsidy budget to handle the Capital case, but Congress is in a mood to cut requested funds. A bill introduced two years ago to ban any trunkline subsidy was re-introduced last week.

Dr. Kurt Debus is expected to be in charge of National Aeronautics and Space Administration launches both from the Atlantic Missile Range and Pacific Missile Range when ABMA elements formally transfer to NASA. Debus headed ABMA's Missile Firing Laboratory at Huntsville and supervised Army's missile and space launches from Cape Canaveral.

Dr. John P. Ruina will replace Dr. Hector R. Skifter as assistant director of defense research and engineering for air defense. Ruina formerly was deputy for research to the assistant Air Force secretary for research and development. Skifter is returning to his former job as president of Airborne Instruments Laboratory.

In another Pentagon move, Harry Davis will replace Ruina in the office of Courtland Perkins, new assistant secretary of the Air Force for research and development. Davis is now assigned to the office of Dr. Herbert F. York, director of defense research and engineering.

Federal Aviation Agency is asking Congress to slice its Fiscal 1961 budget by $21 million because, it says, Air Force cancellation of eight SAGE super combat centers (see p. 33) eliminates the need for the money. FAA has had to drop plans to tie the air traffic control system into the eight canceled centers, but the system probably will be integrated with existing SAGE centers.

Wrapup

President Eisenhower stands little chance of getting permission to bypass congressional authorization procedures for all space funds but construction and equipment budget. Space committees don't want to give up their right to review the space program annually. . . . Rep. Chet Holifield's House Military Operations Subcommittee plans to ask Air Force to review changes in missile management since the group issued its report on the subject. Hearings will be held as soon as General Accounting Office produces its long-awaited report on Space Technology Laboratories' role in the missile program. . . . House Appropriations Committee is scheduled to report Fiscal 1961 budgets for NASA, CAB and Federal Aviation Agency to the House this week.

—Washington Staff

Defense Centralizes Test Range Authority

Gen. Yates will head new Pentagon office formed to supervise nation's launch, tracking complex.

By Evert Clark

Washington—Defense Department last week created an office to coordinate and supervise the nation's complex of military missile and space test ranges and tracking stations, and named Air Force Maj. Gen. Donald N. Yates to head it.

Yates has been commander of the Atlantic Missile Range, largest of the launching bases, for almost six years and has been coordinator of Defense Department's support activities for the civilian Mercury man-in-space program since last fall (AW Oct. 5, p. 26). He now will be deputy director of defense research and engineering (Ranges and Space Ground Support) under Director Herbert F. York and probably will be promoted to lieutenant general.

USAF Maj. Gen. Leighton I. Davis, now assistant Air Force deputy chief of staff for development, will become commander of the Atlantic Range and probably also will take over the Mercury support job, in which he would report directly to the Secretary of Defense through the Joint Chiefs of Staff.

Dr. York said Defense Department's primary concern is for the future rather than the present. Already there are some 100 missile or space tracking stations outside the U. S. York said Yates' job will be to keep a national inventory of facilities and test plans; assign new missile or space programs to particular ranges where technical considerations do not automatically dictate location; maintain long-range launch schedules and plans for ground environment use; recommend action to York on all proposals for use of ranges and for development, procurement, installation and operation of ground environment equipment to be used in test programs, and provide a focal point for coordination with National Aeronautics and Space Administration.

Alvin G. Waggoner, who has been York's special assistant for guided missiles and space operations, now will be Yates' deputy, with the title of assistant director of defense research and engineering for ranges and space ground support. He will establish the necessary office and staff, which is expected to be no more than half a dozen professional military and civilian employes. NASA may assign a full-time liaison man to Yates' office.

Canaveral's Status

Within the Air Force, the change apparently raises the Atlantic Missile Range, operated by the Air Force Missile Test Center of Air Research and Development Command, to a status almost equal with that of a command itself.

It is expected that ARDC's Ballistic Missile Division—which was at one time scheduled to assume authority over the Missile Test Center—now will not be given this authority.

Since 1958, the Atlantic, Pacific and White Sands missile ranges have been operated as national activities. USAF has run the Atlantic, Navy the Pacific and Army the White Sands Range.

For the time being, the Navy-operated Spasur satellite surveillance fence and the USAF-operated Spacetrack computing center will remain under Defense's Advanced Research Projects Agency, as will the communication and navigation satellite development programs. The satellite programs, however, should be assigned to services by about the beginning of the next fiscal year on July 1, York said.

Walker L. Cisler, president of Detroit Edison Co., has been studying the organization and management of ranges since last fall as a special consultant to the Secretary of Defense. He has made verbal recommendations and has written letters to the secretary and to York suggesting changes, but has not made a formal report.

York said creation of the new office reflects some, but not all, of the changes suggested by Cisler. He said Cisler had made no specific recommendations, for example, concerning coordination of the Navy's Pacific Missile Range with the adjacent USAF Vandenberg AFB, which uses many support facilities of the PMR in its training and operational launchings.

Yates brings to his office both the experience of having supervised "the launching of probably more big rockets than anybody else in the world," and "the point of view of someone who has actually been trying to operate one of these facilities in the field," York said.

Defense Department has been coordinating range activities in the past but "not to the degree and with the well-defined charter" that was considered necessary, York said. Creation of the new office has awaited Cisler's recommendations and "an understanding on our part and NASA's part" as to what was needed, York said. He has conferred with both NASA Administrator Keith Glennan and Deputy Administrator Hugh L. Dryden about the new arrangement, he said.

Functions

Examples of the type of function the new office will have are:

- **Assignment of a new program,** such as the Polaris, Minuteman, etc., to a range.
- **Review of proposals to develop** test equipment if its cost is more than $2 million.
- **Review of request to establish** new ground stations or add NASA equipment to military sites.
- **Settlement with NASA** of military-civilian priority questions if they cannot be resolved at lower levels. No new formal body for coordination with NASA is contemplated.
- **Review of launching schedules,** possibly on a monthly or quarterly basis, but with considerable automomy left with base commanders to make their

Range Maintenance and Operation Contract Air Force Missile Test Center

(Pan American World Airways Estimated Costs and Fixed Fee as Negotiated*)

Fiscal Year	Estimated Cost as per Contract	Fixed Fee	Total Face Value of Contract
1954	$4,839,953	$215,000	$5,054,953
1955	11,727,507	440,000	12,167,507
1956	18,125,521	500,000	18,625,521
1957	43,160,029	1,030,000	44,190,029
1958	53,580,000	1,215,000	54,795,000
1959	70,617,620	1,400,000	71,017,620
1960	81,865,000	1,750,000	83,615,000

*—Includes Radio Corp. of America subcontract for technical services.

own schedules. York said he hopes to keep as much responsibility as possible at the ranges for all functions and to have the ranges initiate as much of the planning as possible.

Past disagreements between Navy and USAF at the PMR-Vandenberg complex now are "pretty well under control," York said, but there is "need for further review and new ones may arise in the future."

New Offer Approval

Approval from the new office will be needed primarily in the area of data acquisition equipments rather than simply a new computer for use at a space tracking center, York said, but the new computer office would have to be notified in order to list it in the facilities and equipment inventories. Only experience will determine exactly what needs prior approval from Yates' office, he said.

Any change in the organizational structure for supervising range operations will indirectly affect many industry contractors. Atlantic Missile Range, for example, has some 30 contractors involved in testing missiles and space vehicles there at any one time, exclusive of the companies who operate the range for Air Force.

Range operation itself has become a major business within the defense industry. One survey has put the figure at $2 billion annually for range services and another $5 billion annually for range equipment. Although this is higher than other estimates, the trend is strongly upward as the need grows for world-wide systems such as the Mercury tracking network.

Range Operation Contract

Pan American World Airways, Inc., has held the Air Force range operation contract since 1953, with Radio Corporation of America, Inc., as its subcontractor for technical services. In that time the contract has grown from $5 million a year to $83 million (see box p. 26).

Pan American President Juan Trippe, RCA President John Burns and Maj. Gen. Donald N. Yates, commander of the Air Force Missile Test Center, recently conducted negotiations which led to what the Air Force calls a "realignment" of responsibilities between Pan American and Radio Corp. of America.

The changes will involve the shift of some 125 RCA employes to Pan American's payroll and will improve operational efficiency of both contractors and reduce dollar requirements, USAF said (AW Apr. 4, p. 34). The areas affected are to be range contractor program management, range planning, and engineering contract monitoring functions.

Since the negotiations, K. M. McLaren, head of RCA's Florida operation, has resigned and the company said it has accepted the resignation with regret. Charles Powers, who was manager of RCA's range operations, has transferred to the job of program manager of RCA's Atlas service in Van Nuys, Calif., and has been replaced by Kenneth R. Rawlings.

In spite of Air Force assurances that no further "realignments" are planned, reports persist in the Florida area that the Fiscal 1961 range contract, which will take effect next July 1, will include still further changes in the relationship between Pan American and RCA. Both companies say they have rejected suggestions, which apparently originated at Defense and higher Air Force levels in the interest of economy, that the range be operated by a single contractor.

The Navy-supervised Pacific Missile Range is not contractor operated. The reason is that it is primarily an operational and training base rather than a test base, and security considerations play a larger part.

Recent Selection

Pan American was recently selected by the Army to establish and operate an electronic environmental test facility and drone test range at the Electronic Proving Ground, Ft. Huachuca, Ariz. The company expects to shift no more than 25 technical and management employes from the Atlantic Missile Range to Huachuca to help in establishing the new range.

Pan American and RCA won the Atlantic Missile Range contract in 1953. Forty-five companies were invited to bid and six company proposals were finally considered. The companies were Pan American-RCA; Fairchild Engine & Airplane Co.; Land-Air, Inc.; Day & Zimerman, Inc., in conjunction with Philco and Trans-Ocean Airlines; Federal Telephone and Radio; Paul Smith Construction Co.

An evaluation project group established subpanels to examine and evaluate supply, air support, management, technical systems planning, photographic service, data acquisition, data reduction, phase-in period and range operations planning. Later, over-all panels composed of senior officers reviewed the work of the subpanels and selected Pan American.

Air Force last year explained the selection to the House Defense Appropriations Subcommittee in the following way:

"While costs were considered, it was recognized that a cost-plus-fixed-fee contract was involved, and the government would, therefore, be required to bear all costs incurred regardless of original estimates proposed by each contractor and contained in any contract written.

"In addition, the proposals varied extensively as to method of operation and manpower requirements so as to make cost comparisons an impractical basis of evaluation. The other factors . . . relating to technical, operational and logistical areas, became the primary basis for evaluation and award."

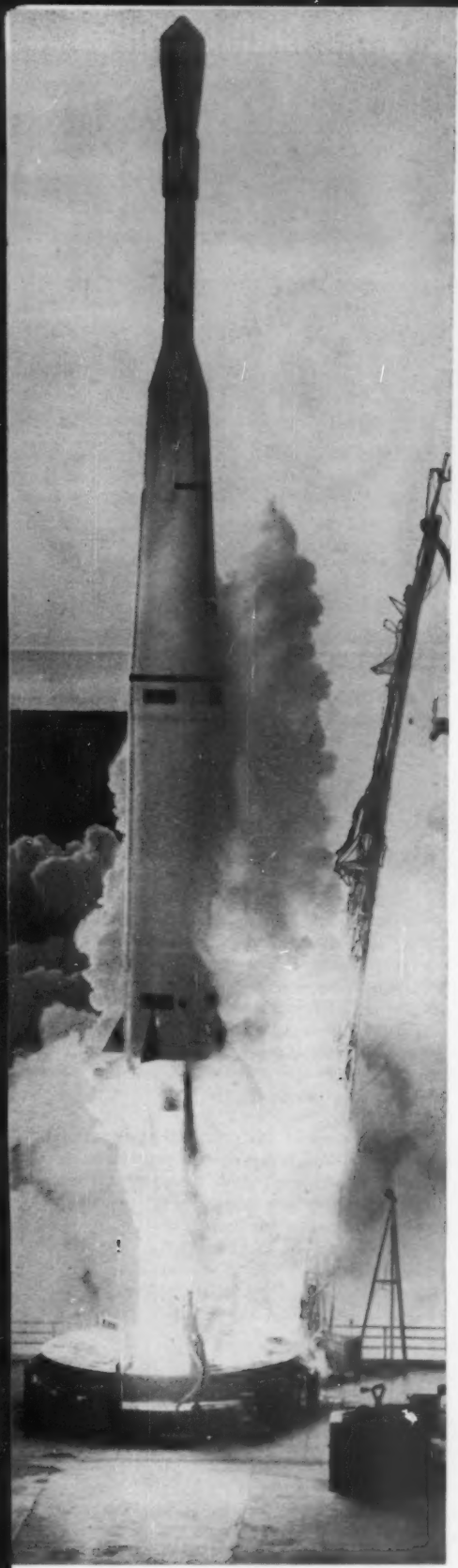
Mercury Capsule

First McDonnell Project Mercury manned space capsule airframe, instrumented for escape system tests, has been delivered to National Aeronautics and Space Administration at Wallops Station, Va. (AW Mar. 21, p. 34). Next Atlas booster test of capsule will include evaluation of fuselage skin shingles which are designed to compensate for aerodynamic heating.

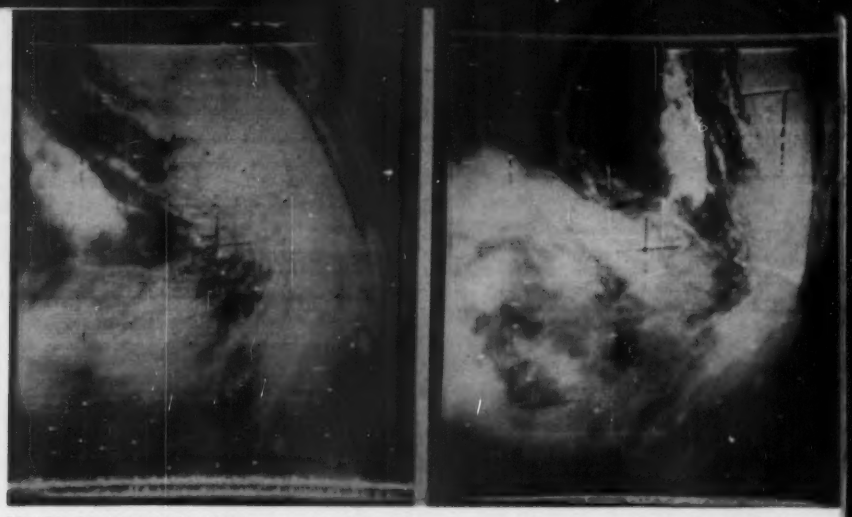
Contract Cost

The Atlantic Range contract has cost some $285 million in seven years. Pan American's estimated cost for the current contract is $81.9 million and its fee, which is negotiated, is $1.75 million, or 2.13%. RCA's estimated cost is $28,211,000 and its fee is $925,000, or 3.39%.

As of the middle of last year, Pan American had 4,858 employes at the Missile Test Center and RCA had 3,112 (AW Aug. 31, p. 56).



TIROS I was launched by Thor-Able guided by Bell Telephone Laboratories system developed for Titan.



SERIES OF PHOTOGRAPHS transmitted by Tiros I were taken by satellite's low-resolution

NASA Tiros I Demonstrates

By Craig Lewis

Washington—Tiros I is returning pictures of the earth and its cloud cover in a practical demonstration that satellites can be used to survey weather conditions and other surface features from space.

Tiros is an experiment rather than an operational weather reconnaissance system, but it is testing the basic flight and ground techniques that will be used in future operational systems (AW Mar. 14, p. 27). The satellite has returned about 2,000 pictures thus far in the 10 days it has been in orbit, and, as it continues to transmit pictures from its television system during its three-month life, it is expected to demonstrate the feasibility of using orbital platforms to provide a major breakthrough in worldwide weather reconnaissance and forecasting.

Since Tiros can photograph Communist land areas, it raises touchy international questions. Although there was no adverse reaction from Communist nations when the satellite was launched, NASA has taken pains to emphasize that its television cameras can detect only large terrain features and that they have no capability for detailed surface reconnaissance. NASA revealed last week that the high resolution camera has a design resolution of about 0.2 mi. An object this size would show as a blip on one of the 500 lines in a picture, and NASA said it would be impossible to identify.

Despite the disclaimers, the agency is carefully screening all photographs before they are released to make sure no features of a sensitive nature are displayed. Tiros is photographing such areas as Mongolia, China and southern and eastern Russia in its passes around the earth. State Department and Central Intelligence Agency are disturbed by the international complications which could arise from the success of the Tiros experiment.

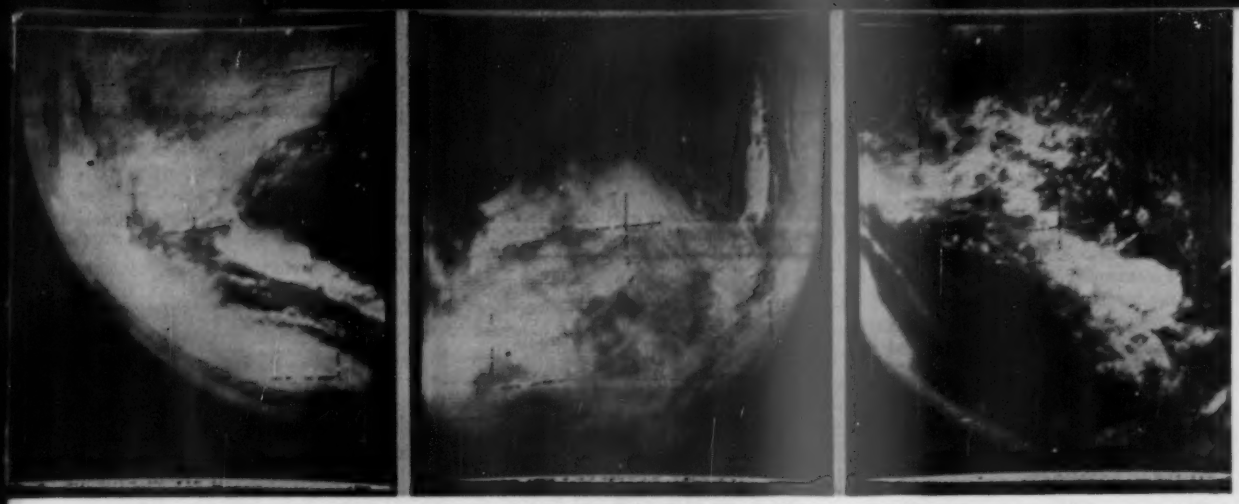
Although the Tiros system is aimed at meteorological research, its success obviously demonstrates the feasibility of the general principles that will be used in military reconnaissance satellites.

The same photographic clarity which poses international problems also proves the value of satellite reconnaissance for meteorological use. The exact utility of Tiros' pictures in weather mapping and forecasting was hard to assess immediately after launch, but meteorologists are pleased with the results and the proof the photographs provide of the validity of weather satellite concepts. Future problems would seem largely to involve the development of a more sophisticated, operational system.

Tiros was preceded by Vanguard II, which had a photocell for mapping cloud cover. Vanguard wobbled in orbit, and data has been extremely hard to interpret. Explorer VI also telemetered a crude picture of cloud cover, but its quality did not approach the pictures coming from Tiros. Explorer VII is telemetering data on the heat budget of the earth from its infrared detectors.

Tiros II Schedule

NASA will extend its meteorological satellite program into the infrared area with Tiros II, which is scheduled for launch in August by a Thor-Delta vehicle. Nimbus follows Tiros in the NASA program, and this advanced satellite will be closer to an operational configuration. It will be earth oriented and fly a polar orbit, correcting the two big drawbacks of the space-oriented Tiros. It also will have more advanced sensors



camera, which covers an area about 800 mi. square. Cloud cover images show utility of a satellite system in weather reconnaissance.

Potential Satellite Reconnaissance Utility

for measuring meteorological conditions near the earth's surface.

Tiros and NASA's meteorological satellite program are part of a growing effort to improve the means of mapping and forecasting weather conditions.

Systems in Development

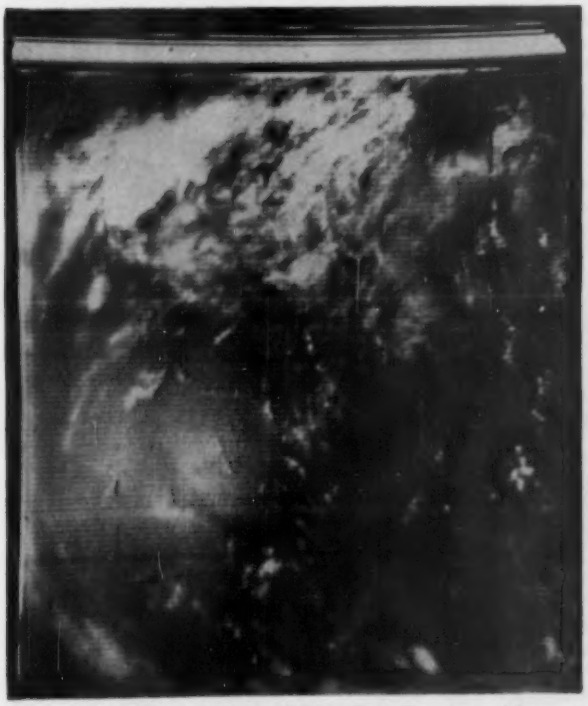
The Air Force has systems under development that are designed to improve weather data collection and to integrate collection and forecasting techniques into an operational system, and the Weather Bureau has a continuing effort to improve techniques.

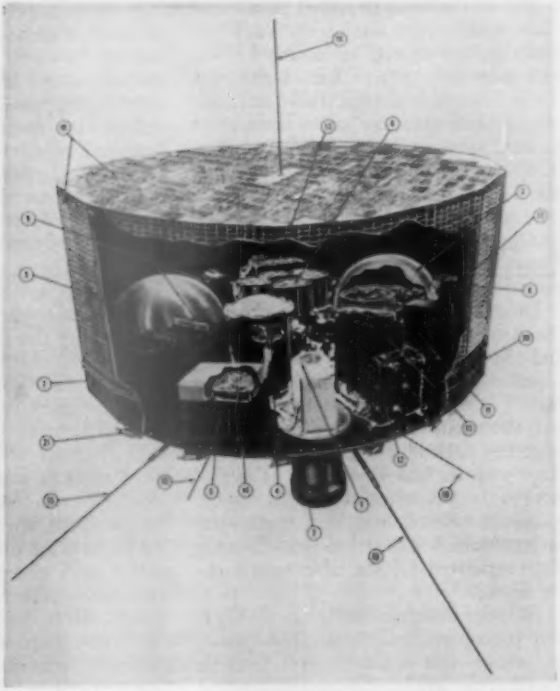
The operational system that will eventually follow Tiros will dovetail with these programs.

Tiros I was boosted into a circular orbit by a Thor-Able launch vehicle. It has a perigee of 435 stat. mi. and an apogee of 468 stat. mi. Inclination to the equator is 49.327 deg., a value within .003 deg. of the intended inclination. Velocity at burnout was within 22 fps. of the desired value. The orbital period is 99.15 min., and the satellite is expected to make about 1,300 passes around the earth during the estimated three-month lifetime of its systems.

Tiros Coverage

Tiros covers the surface of the earth between 50 deg. north and south latitudes, a band extending roughly from Montreal, Canada, and Santa Cruz,





HIGH RESOLUTION CAMERA (left) in Tiros I can record images as small as 0.2 mi. Cutaway of Tiros shows: 1—one of two half-inch Vidicon TV cameras; 2—wide-angle camera lens; 3—tape recorders; 4—electronic sequencer; 5—TV transmitter; 6—batteries; 7—camera avionics; 8—tape recorder avionics; 9—control circuits; 10—auxiliary controls; 11—tape motor power converter; 12—voltage regulator; 13—battery regulator; 14—auxiliary synchronizing generator for TV; 15—transmitting antennas; 16—receiving antenna; 17—solar sensor; 18—solar cells; 20—de-spin mechanism; 21—spin-up rockets.

Meteorological Probes

Washington—U. S. is beginning a program for a periodic series of daily sounding rocket launches to gather meteorological data at altitudes of up to 200,000 ft. to add to the information now obtained from weather balloons and the Tiros I meteorological satellite.

Month-long daily firings of Loki and Arcas rockets will be made this spring, summer and fall from Wallops Station, Va.; Pt. Mugu, Calif.; Tonepah, Nev.; Eglin AFB, Fla., and Cape Canaveral, Fla. Daily launches of Loki and Arcas were made from Wallops Station and Pt. Mugu from Jan. 18 to Feb. 19 in an early demonstration of the program.

Sounding rocket network will be part of the U. S. contribution to the International Rocket Weeks sponsored by the Committee on Space Research. First of these COSPAR programs was conducted last November, and the next is scheduled for September. They are planned quarterly in 1961.

The U. S. network is a joint project involving the Air Force, Army Signal Corps, Atomic Energy Commission, National Aeronautics and Space Administration, Navy and Weather Bureau. Army Signal Missile Support Agency provided and launched the initial test rockets.

Argentina, in the Western Hemisphere.

The satellite was launched by a Thor-Able vehicle very similar to the Thor-Delta NASA expects to launch for the first time this spring. Like Delta, the Tiros Thor-Able carried the Bell Telephone Laboratories radio command guidance system designed for the Titan ICBM. This Bell Telephone system also was used in the Thor-Able Phase 2 nose cone re-entry tests. The Aerojet-General second stage used in the Tiros launch was a surplus stage from the re-entry test program.

Launch was under the direction of the Air Force Ballistic Missile Division and Space Technology Laboratories. Douglas Thor first stage burned approximately 160 sec., and, just before burnout, the plastic fairing around the third stage and payload was jettisoned. Second stage with its Bell Telephone Laboratories guidance system powered the vehicle for about 100 sec., and, at burnout, spin rockets stabilized it at 136 rpm. Second stage separated 1.5 sec. after spin rockets fired.

Hercules-Allegany Ballistics Laboratory solid propellant third stage coasted for about 400 sec. before it ignited. Third stage separated from the payload 25 min. after it burned out. The third stage carried a beacon designed by Lincoln Laboratory and built by Texas Instruments and, for the first time in a NASA satellite launch, the third stage could be beacon-traced by radar.

Tiros I is a 270 lb. satellite equipped with two television cameras. It is 19 in. high and 42 in. in diameter, and it was designed in a drum-like shape to support the more than 9,000 solar cells which cover its sides and top.

Designed and built by Astro-Electronic Products Division of Radio Corporation of America under technical direction of Army Signal Research and Development Laboratory, the satellite has two television cameras which are identical except for lens equipment. Low resolution camera has an *f* 1.5 lens; the high resolution camera has an *f* 1.8 lens. Shutter speed is 1.5 millisecond. Pictures have 500 lines per frame, and the video bandwidth of the system is 62.5 kc.

Each camera is connected to a magnetic tape recorder that can record as many as 32 photographs at 30 sec. intervals while the satellite is out of transmission range of ground stations, although the camera doesn't necessarily take 32 pictures on each pass. Cameras also can bypass the recording system and transmit pictures directly to a ground station. This procedure is followed after the stored pictures have been transmitted and while Tiros is still in range. It takes 7.5 min. to record the pictures stored by the two camera systems, and the satellite is in range up to 12 min.

The two television camera systems and their associated equipment operate independently and transmit data through two-watt telemetry systems operating on 235 mc. Recorder tapes are 400 ft. long and move at 50 in. per second in recording and playback. Transmitted data is taped and also is displayed immediately on ground station television displays where it is photographed. Pictures and taped data are sent to Naval Photographic Interpretation Center for processing.

Since the satellite is space oriented, it can photograph the earth cloud cover only during the part of its orbit when it is pointed at the earth and while that part of the earth is in sunlight. During a pass, Tiros will take a series of overlapping pictures.

Orientation of the pictures is provided through sun-angle sensors in the solar cell units that provide readings on the satellite's orientation to the sun as the pictures are shot. This data is transmitted with the pictures. Attitude information comes from an infrared sensor which detects the earth's horizon. Two transmitters broadcast continuously, providing tracking information and transmitting duplicate data on satellite attitude, environmental conditions and equipment operation.

Minitrack stations provide data on the satellite's orbit and attitude to NASA's computing center here. Computing center calculates future orbits and prepares operational programs which Tiros can carry out during the time its cameras are pointed at the earth. The projected programs are coordinated with data compiled by Weather Bureau's Meteorological Satellite Section.

Information from these sources is used by the operations control center at NASA's Goddard Space Flight Center to plan the actual program the satellite will follow. Instructions are then sent to the two ground stations which instruct the satellite system and receive its photographs.

These ground stations are facilities operated by the Signal Corps at Ft. Monmouth, N. J., and by Lockheed Missile and Space Division at Kaena Point, Hawaii. Backup stations at Cape Canaveral, Fla., and Princeton, N. J., can receive data but can't instruct satellite.

The photographic programs are run through a General Time electronic clock system that can be set as much as five hours in advance as Tiros passes over one of the two ground stations. Clock system triggers the cameras at the proper time and controls the picture-taking and recording program.

After the Tiros photographs have been processed by the Naval Photographic Interpretation Center, they are sent to the Weather Bureau and to Air Force Cambridge Research Center.

B-58 Reliability

Reliability increments assigned to the 28 major subsystems in the Convair B-58 show that its bombing and navigation system is responsible for 60.5% of the malfunctions that degrade the aircraft's bombing capability.

This was brought out by Convair engineers who participated in a Society of Automotive Engineers symposium on "Reliability—Organization and Achievement" in the B-58 weapon system.

Comparable increment for the B-58 long-range communication system is 10.6%; for its fuel and air refueling system, 5.6%; for its utility hydraulic system, 5.2%; for its flight control system, 3.0%; and for its engines, 2.9%.

Although "realistic mean time between engine failures" is listed as 250 hr. for reliability test purposes, loss of an engine during the strike phase of a typical mission does not result in 100% degradation, for the B-58 can attain supersonic speed on three engines.

By feeding 4,000 algebraic equations—each representing an acceptable mode of bomb delivery despite subsystem malfunctioning—through an IBM 704 computer, Convair is able to determine the probability at takeoff that the B-58 will deliver and detonate a nuclear weapon within a fixed target radius.

Aerospace Coordinating Board Planned

By Ford Eastman

Washington—Aerospace Activities Coordinating Board will be created to help implement President Eisenhower's proposed changes in the National Aeronautics and Space Administration, NASA Administrator T. Keith Glennan, told the House Space Committee last week.

Purpose of the board, Glennan said, will be to facilitate cooperation between NASA and the Department of Defense for the solution of problems of mutual interest and for the exchange of information on requirements, technical data and progress of programs. Board would operate at a substantially higher administrative level than the present Civilian-Military Liaison Committee it will replace.

The deputy administrator of NASA and the director of defense research and engineering will serve as permanent co-chairmen of the board. The chairman will be assisted by officials of each agency who deal in special areas calling for coordination, such as launch vehicles, biosciences, aeronautics and payloads.

Formation of the board was suggested by James H. Douglas, Deputy Defense Secretary, when he appeared before the committee in support of the President's request to modify the National Space Act (AW Mar. 21, p. 30). It was one of several proposals recommended to the committee headed by Rep. Overton Brooks (D.-La.), during the month-long hearings. The committee is expected to report on its recommendations within a week.

With the exception of the Coordinating Board, Glennan rejected all proposals to amend the act beyond the changes requested by the Administration and said he hopes Congress will "avoid substituting some new organizational complexity in place of an old one." He said the President, in requesting the changes, "is seeking to increase the effectiveness of government through a simpler, more flexible organization."

The President has asked Congress to eliminate the National Aeronautics and Space Council and shift space planning functions back to NASA, abolish the Civilian-Military Liaison Committee and clearly define NASA as the agency to explore space, while military functions in space would be confined to those pertaining to national defense (AW Jan. 18, p. 35).

Other proposals suggested to the committee by military and civilian witnesses included:

- **Establishment of a single** national space program embracing both civilian and military applications and headed by either the Defense Department or the civilian agency.
- **Substitution of either a "czar,"** committee or board for the National Space Council to head the space program.
- **Substitution of a Military** Applications Committee, Military Liaison Committee or both for the Civilian-Military Liaison Committee.
- **Creation of a Joint Congressional** Committee on Aeronautics and Space to replace the present House and Senate standing committees.

In commenting on the proposals, Glennan said creation of a space czar would alter the President's present authority and power of decision over the Defense Secretary and the NASA administrator. He said:

"It must be assumed by those who advocate the creation of such an office in the White House that the President cannot, because of his multiple duties, give the nation's space activities the attention they deserve. I cannot accept this assumption, nor is there any basis for it in the experience of the last year and a half. I have had no difficulty in reaching the President and obtaining decisions."

Regarding the proposal for creation of a group similar to the Atomic Energy Commission's Division of Military Application, Glennan said the relationship between the Defense Department and AEC is essentially that of user and supplier, while the relationship between NASA and Defense is substantially different. He said such a committee would not solve the problems of coordination, decision-making and cooperation.

In a related development, the committee last week released testimony taken during earlier closed sessions in its review of the national space program. Witnesses included Dr. Herbert F. York, Defense Department director of research and engineering, who told the committee:

- **Improvement program** to simplify missile construction has resulted in a 10 to 20% reduction in the number of valves in a Convair-Atlas intercontinental ballistic missile engine.
- **Defense Department's** communications satellite program "may end up waiting for a booster." York said the net loss in time, however, should be small.
- **Expenditures for space,** missile and satellite programs by the government will amount to about $6.5 million in Fiscal 1961.
- **Total research, development,** test and evaluation funds in the procurement budget and line items for missiles goes from approximately $2.15 billion in Fiscal 1960 to about $2.4 billion in Fiscal 1961.

In reply to questioning, Lt. Gen. Bernard A. Schriever, commander of the Air Force Air Research and Development Command, denied that the Air Force is establishing a separate training program for space crews. He said USAF is developing plans for the Dyna-Soar boost-glide program in which NASA is participating.

"We will not be carrying out two separate uncoordinated efforts here at all," he said. "Just like the X-15, we have Air Force, Navy and NASA personnel who will actually participate in the flight program . . ."

Gen. Schriever also detailed the scheduled operational dates for NASA's Project Mercury tracking and ground

Anti-ICBM Ray Research

Washington—Air Force is backing a research program on a ray-type anti-ICBM research project, although at a lower level than its project leaders have recommended.

Dr. Joseph Charyk, Under Secretary of the Air Force, told the House Committee on Science and Astronautics that his office and the Air Force Scientific Advisory Board are still reviewing a proposal that $10 million in Fiscal 1960 funds be spent to build an experimental facility at Yucca Flats, Nev., to be used specifically for work on ground-based high energy devices which theoretically can stop ICBM warheads above the atmosphere. Charyk said there are still major technical uncertainties with such devices which radiate microwave energy or accelerate high energy particles.

Charyk said the Scientific Advisory Board will recommend an acceleration in the project's funding if more promise of solving the basic problems can be demonstrated. He described the Air Force project as "a supplement" to the work of Defense Department's Advanced Research Projects Agency work in this area and said it was undertaken because USAF felt "augmentation to the ARPA effort was desirable." The ARPA program for a ray-type ICBM defense is a portion of the GLIPAR (Guide Line Identification Program for Anti-Missile Research) project whose main purpose is to stimulate scientific thinking away from conventional approaches to the missile defense problem.

instrumentation stations. They include the following:

- **July, 1960**—Cape Canaveral, Fla., Grand Bahama, Grand Turk, Bermuda and the control center at the Air Force Missile Test Center at Canaveral.
- **September, 1960**—Canary Islands.
- **November, 1960**—Washington, D. C., communications and control center, West Australia, Hawaii, West Mexico, Southern California and South Texas.
- **January, 1961**—Indian Ocean and mid-Atlantic shipboard installations, Nigeria, Zanzibar, Woomera (Australia), Canton Island, White Sands and Eglin AFB, Fla.

Turbojet, Ramjet De-Emphasis Deplored at Agard Conference

By David A. Anderton

Milan—Serious concern that the end of the air-breathing engine era is in sight was voiced by many powerplant engineers at the Fourth Agard Combustion and Propulsion Colloquium here last week. Agard is NATO's Advisory Group for Aeronautical Research and Development.

While scientists in formal sessions discussed future air breathers from theoretical and design viewpoints, observers of major U.S. and British engine companies privately emphasized fears that the turbojet and ramjet have no future.

Major reason is the current emphasis on ballistic missiles and their liquid propellant powerplants which take the lion's share of current budgets, leaving nothing for research and development of air-breathing powerplants.

Only possible future market for engines of advanced design appears to be a commercial transport. But such engines have to be financed by companies without government help, as the situation stands. With the current high cost of powerplant development programs, no engine company—even in collaboration with customers—could afford to complete the cycle of development for a new air-breathing engine.

Biggest disappointment to many engineers has been the lack of money allocated by the National Aeronautics and Space Administration to basic air-breathing engine development. After Agard Chairman Prof. Theodore von Karman broke from a prepared speech to criticize NASA's attitude, speaker after speaker pointed out areas where basic and applied research is needed in order to provide more adequate design information for supersonic turbojets and hypersonic ramjets. Most designers accept the current facts of life and realize that what they call overemphasis on ballistic missiles stems from a military decision to concentrate on these kinds of missiles. "Let's face facts," said one, "There are no new military requirements for our engines." Engineers are seriously concerned to keep a few key people in engine development and they point out once design capability is lost it is never regained.

They feel this keenly right now because basic techniques for design layout of high supersonic turbojets and hypersonic ramjets are finally fairly well understood. Work remaining is largely experimental and developmental that takes time, money and test facilities. Some applications of air-breathing engines such as staged supersonic transports, air launching vehicles for ballistic missiles, satellites or sounding rockets are just beginning to look promising based on available data and prospects for the near future. A proposal by Antonio Ferri of Brooklyn Polytechnic featured a Mach 7 transport weighing 600,000 lb. carrying 100 passengers over a 6,000 mi. range. The plane is powered by a combination turbojet-ramjet. Another Ferri proposal foresees satellite capabilities in a combined powerplant aircraft using turbojets for takeoff and acceleration to Mach 3.5. Ramjets with subsonic combustion would continue acceleration to Mach 7 and above Mach 7 combustion would be supersonic. Fuel and coolant would be hydrogen.

Even though accelerations are low, eventual velocity would be orbital. Payloads placed in orbit would be on the order of 10,000 lb.

M. A. Zipkin, of General Electric, delivering a paper prepared by him and I. M. Nucci of General Applied Science Laboratories, used three illustrations:

- **Two-stage supersonic transport** carrying 60 passengers, having a range of 3,500 naut. mi. and Mach 4 cruise. Boost vehicle weighing 64,000 lb. and turbojet powered takes off combined with the cruise vehicle weighing 75,900 lb. and separates after accelerating both vehicles to Mach 4. The cruise vehicle continues the trip on ramjets, using turbojets for landing.
- **Republic F-105** used to launch satellites. A two stage rocket weighing 10,300 lb. is launched using zoom technique, putting 120 lb. in orbit.
- **Republic F-105** used to launch sounding rockets the same way. The plane could launch a 100 lb. payload to an altitude of 340 mi. compared with 190 mi. reached using ground launch for the same rocket.

A. Burstein, Convair assistant chief engineer, said a typical rocket used 63% of its total energy getting through the atmosphere. Studies of recoverable launching systems showed they are competitive in cost with ground-launched rockets designed to put comparable loads in orbit.

But no companies have enough private funds to finance a single program of this type including test facilities. Current test areas are tied up with rocket powerplants or are incapable of special tests needed to satisfy the designer of a Mach 7 ramjet. "I visited Lewis Lab the other day," said one designer, "and there wasn't a test cell there with an air-breathing engine. And what's worse is there isn't going to be any."

But NASA's A. M. Rothrock said the reason NASA cut down that type of research testing is because it seems design and development of these engines and their vehicles is a matter of engineering rather than reseach. He said the payoff in going to hypersonic speeds in transports is so small it hardly seemed to justify choice of Mach numbers above the range of Mach 2-3. He questioned earlier presentations showing hypersonic transports with ranges up to 6,000 mi., saying, "We all don't want to go from New York to Moscow and the time we spend getting to and from those points would be a major portion of the total trip time." Rothrock recommended staying between Mach 2 and 3 for supersonic transports.

Lack of discussion time saved him from immediate arguments, but one by one proponents of air-breathing engines cornered him for debate. One scientist said later, "Rothrock is wrong on all counts. He is just trying to rationalize the NASA budget."

"As long as guys like him are in charge of funds, the air breather sure doesn't have any future," commented an engineer with ramjet experience.

But Rothrock wasn't the only target. Several designers had equally harsh words for the military in spite of Maj. Gen. Daniel Hook's statement that USAF will devote "adequate" funds to air-breathing engines and Vice Adm. J. T. Hayward's comment that he is in favor of air breathers. One engineer said, "How can you believe them? Schriever (Lt. Gen. Bernard A. Schriever) cut out turbojet money and one of his boys comes here and says the Air Force is continuing adequate support."

But the bitterest comment came from a scientist who said the only way he could see to get back into the air-breathing engine business was for the military to find out the Russians are doing it. "If that ever happened," he said, "we would have all the money we could use."

Pioneer Signals May Be Received From 75-Million mi. Distances

Washington—Signals from National Aeronautics and Space Administration's Pioneer V space probe are expected to be triggered and received at the University of Manchester's radio-telescope at Jodrell Bank, England, station when this sun-orbiting satellite is as far as 60 to 75 million mi. from earth. Original estimates had placed the maximum signal distance at approximately 50 million mi. (AW Mar. 21, p. 28).

Farthest distance from earth the Pioneer vehicle will reach within the next year will be about 87 million mi. Closest approach to earth will be about 16 million mi.—in October or November, 1965.

Approximately 311 days after its Mar. 11 launch, Pioneer V will be closest to the earth's orbit—about 10,000 mi. This will be a yearly occurrence.

Closest approach to the orbit of Venus will be made on about Aug. 9 when the probe will be 43.5 million mi. from earth and about 7 million mi. from the Venus orbit. Closest approach to Venus itself, approximately 22 million mi., will be made in September, 1961.

Highlights of Pioneer V include:

• **Mar. 11 launch**—Probe began sending at 64 bits per sec. from the 5-watt transmitter. Ten bits are the equivalent of one word.

Signals were received at six ground stations at various times for a total time of two-and-one-quarter hours per day. The Manchester tracking facility triggered the signal for associated stations at Millstone Hill, Mass., and Cape Canaveral, Fla., while the Hawaii station turned on the signal for reception at Singapore and Goldstone, Calif.

• **Mar. 12**—Pioneer V was about 200,000 mi. from earth, when the switch was made to 8 bits per sec. for reception at Hawaii, Millstone, Goldstone, Singapore and Cape Canaveral, because of the transmission distance involved. The Manchester facility was still receiving information at 64 bits per sec.

• **Mar. 13**—Probe was approximately 313,000 mi. out. Communications were lost at Cape Canaveral and Singapore because of their small antenna installations. Manchester was still receiving at 64 bits per sec., Hawaii at 8 bits per sec. Goldstone and Millstone were not turned on.

• **Mar. 17**—Same transmission situation existed except that Hawaii was receiving at 1 bit per sec. because of the long range, about 1,113,000 mi.

• **Mar. 20**—Manchester reception was reduced to 8 bits per sec., with reception situation at other stations remaining the same. Pioneer V distance from earth was approximately 1,373,000 mi.

• **Apr. 5**—Transmission situation continued, with Pioneer V's distance from the earth at about 3,376,000 mi.

• **May 20**—Probe will be about 10 million mi. from earth. Since reception on the 5-watt transmitter will be marginal, it is probable that the vehicle's 150-watt transmitter will be activated. This will be accomplished with an amplifier for the 5-watt transmitter.

• **May 22**—Vehicle will be about 10,300,000 mi. out. Manchester reception will be reduced to 8 bits per sec., Hawaii will remain at 1 bit per sec., and other stations will not be in contact.

• **June 15**—Pioneer V will be about 20 million mi. from earth. Manchester reception will be reduced to 1 bit per sec., and there will be no contact with the other stations.

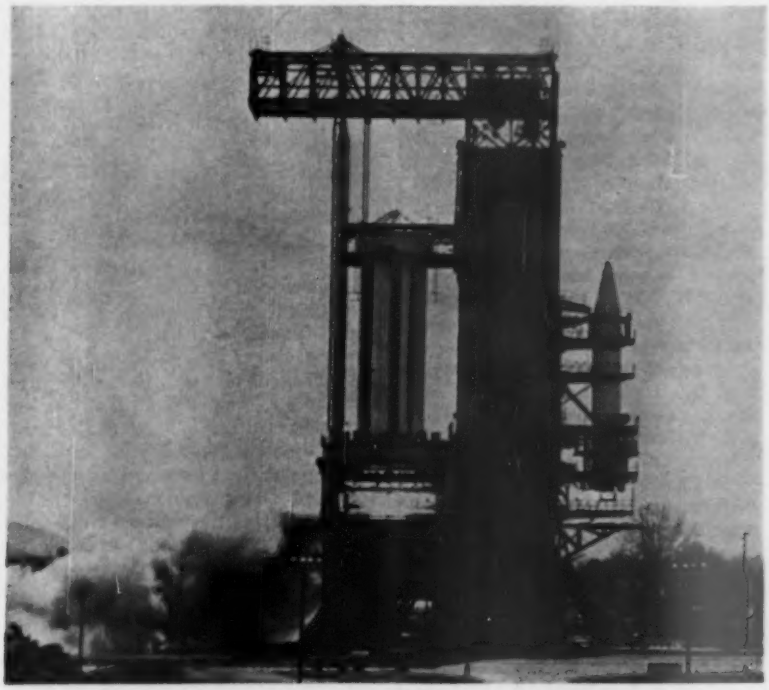
Under NASA cognizance, the payload was designed and instrumented by Space Technology Laboratories, including the receiver, the five transmitters and associated avionic devices in the integrated telemetry, tracking and command system.

USAF Plan Approved

Washington—Plans to fund long lead-time items for six additional Polaris submarines and for construction of 18 more Convair-Atlas ICBMs than originally requested in the Fiscal 1961 budget were formally approved last week by President Eisenhower.

Funds for expanding the Atlas and Polaris programs will come from cancellation of plans to construct two nuclear-powered attack submarines, saving $114 million, plus a cutback on the Air Force Bomarc-B interceptor missile and SAGE supercombat centers (AW Apr. 4, p. 29). Funds saved by cancellations will exceed by $99.7 million the increased Polaris and Atlas funding plus the cost of accelerating USAF's Samos and Midas satellite programs, interceptor and radar modernization and an increase in the BMEWS program, also approved by the President.

Administration's revised program will bring the total Atlas missiles in the Fiscal 1961 budget to 58 and the total Polaris submarines fully or partially funded to 21. In subsequent testimony before the House Defense Appropriations Subcommittee, Defense Secretary Thomas Gates said that, if Polaris tests scheduled for August prove fully successful, the Administration will ask Congress for additional funds.



Two Saturn Booster Engines Test-Fired

Two of the eight engines clustered in the Saturn booster are test-fired above at Huntsville, Ala. (AW Apr. 4, p. 31); test was followed by test-firing of four engines. Each engine produces 188,000 lb. thrust. At right of the static stand is a 60-ft.-long Jupiter intermediate range ballistic missile in position for test firing.

Gen. Power Details to Senate SAC Air Alert, Missile Needs

Washington—Gen. Thomas S. Power, commander of the Strategic Air Command, last week enlarged upon the actions which he feels are necessary to provide the U.S. with a continuing deterrent capability, including his proposal for a 24-hr. SAC airborne alert.

In testimony before the Senate Defense Appropriations Subcommittee, Gen. Power, however, denied reports that he is asking that "we start on airborne alert immediately." He added:

"This is not so. I do not consider it is necessary to undertake a full scale flying airborne alert program today. What I have asked for and recommended is the earliest capability so that it may be initiated when it is required. Due to the lead time required to procure the necessary materiel, funds must be made available today to commence the necessary stockpiling."

He also told the subcommittee that a misconception of this program is the belief that a lot of money would be wasted if it never became necessary to implement airborne alert.

"The actual fact is that stockpiling action will not represent a loss even if airborne alert is never implemented," he said. "Obviously the B-52 force is going to be with this command for a long time, and the additional parts could, and would, be consumed under normal operations. In effect, this would permit reduced procurement for future years."

Gen. Power reiterated his stand that an "airborne alert is the only answer to reducing Soviet confidence that a surprise attack could eliminate nuclear strike capability of the Free World."

He told the subcommittee that "there is no suitable alternative until we can be guaranteed reliable and effective missile warning systems, coupled with a force postured and configured to be responsive to whatever warning is available. Airborne alert of the B-52 force can, from the standpoint of calendar time, carry us through to the next plateau when missiles should be entering our inventory in quantity."

While Gen. Power did not place a price tag on his proposals for a continuous airborne alert capability, Sen. Dennis Chavez (D.-N.M.), subcommittee chairman, said it would cost about $570 million in Fiscal 1961 and between $800 million and $850 million annually thereafter. Administration has requested $85 million in Fiscal 1961 to provide an on-the-shelf alert capability.

Earlier, Maj. Gen. R. J. Friedman, comptroller and director of the Air Force budget, told the House Defense Appropriations Subcommittee:

"We have the $185 million in the budget now. (He referred to the $85 million requested in Fiscal 1961 plus $100 million that would be available through Fiscal 1960 programing.) It would require $492 million more than that in Fiscal year 1961 to build up to the capability that Gen. Power wants by Jan. 1, 1962. Then there would be a requirement for some $250 million more than that if, after having attained that capability, you decided to keep the aircraft on continuous alert as of that date. Then you would have to reprogram $70 million in Fiscal 1960. Then the following 12-month period would cost you $801 million to maintain that activity." Gen. Power also told the subcommittee that the U. S. should:

- **Build, "as rapidly as possible,"** an effective ballistic missile capability. He said he supported proposals to augment the number of missiles in the Convair-Atlas ICBM squadrons to switch to an improved version of the Martin-Titan (AW Apr. 4, p. 34). The improved Titan, he said, "gets away from propellant storage problems. You have an in-silo launch capability and an improved all-inertial guidance system. This simplified system will result in a capability to reduce the number of people per squadron by about 50%.

"These missiles should be followed as quickly as possible by the second generation missile—Minuteman. It is in this system that SAC is placing a lot of faith for the future. In my opinion, there will be a requirement for a sizable Minuteman force in order to achieve an effective counterforce capability."

- **Continue research** and development of manned bomber systems to provide a mixed force of manned and unmanned systems for flexibilty. "We must continue the concept of a mixed force," he said, "and the [North American Mach 3] B-70 will provide the best capability in the manned aircraft for this time period [beyond 1965]. The B-47, which has been the backbone of our deterrent posture, will be phased out of the inventory due to obsolescence. It will be replaced to some extent by [Boeing] B-52s and [Convair] B-58s, but primarily by missiles. With a combination of these systems in the proper mix, deterrence can be best assured for the immediate future."

Gen. Power also urged the adoption of personnel measures that will attract and hold a "qualified, professional, and dedicated corps of officers and airmen." He suggested the following actions:

- **Augment the present spot** promotion program. This would require legislation modifying the Officers' Grade Limitation Act to provide an increased grade structure for combat crews.
- **Implement the officer responsibility** pay section of the military pay bill.
- **Provide alert pay authorization.** "I want to give them [alert crews] $10 a day for every 24 hr. they are on alert."
- **Provide accrual pay** "wherein a rated officer is guaranteed so much of his flight pay based on years of service when removed without cause, from flying."
- **Implement Capehart Act** to include housing for airmen in lower ranks.

Douglas Cuts Salaries

Santa Monica, Calif.—Douglas Aircraft Co. initiated a 10% reduction in pay for all salaried personnel last week, accompanied by a 60-day moratorium on merit increases.

Salaries of corporate officers are reduced by at least the same amount. Donald W. Douglas, Sr., chairman of the board, and Donald W. Douglas, Jr., president, each are accepting a 25% salary reduction.

"Reasonable and realistic reductions in administrative costs and other constructive economies in over-all operations already in effect should help place the company in a stronger competitive position at this critical period of readjustments in the markets of the industry," the company declared.

Douglas says that 14,500 salaried personnel are affected by the cut but that no one will be cut below the minimum for their job classification. The company's action comes at a time when union and management officials are at the negotiating table and just prior to its annual report to stockholders.

The UAW-IAM issued a statement saying that the pay cut was merely a crude attempt on the company's part to attempt to intimidate workers covered by UAW-IAM contracts into accepting terms less favorable than the economic facts would indicate.

Spokesmen for North American Aviation, Inc., Lockheed Aircraft Corp., and Northrop Corp., told Aviation Week that their companies did not contemplate action similar to Douglas' at this time.

At Chance Vought Aircraft, Inc., a two-year contract, calling for a general wage increase of five to seven cents per hour and pro rata vacation was signed by the company and International Brotherhood of Electrical Workers, Local 59.

Republic Aviation Corp. and the International Assn. of Machinists agreed on a new two year pact covering 8,500 employes at Farmingdale, L. I. Agreement calls for a wage boost ranging from seven to 11 cents an hour the first year, and five to eight cents the second year. Average hourly wage before the settlement was $2.63.

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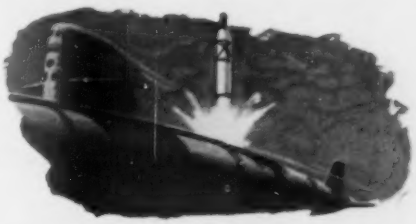

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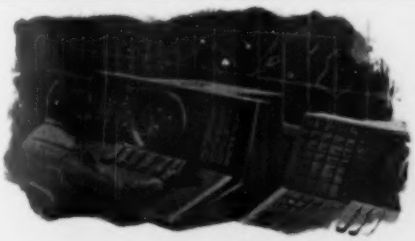

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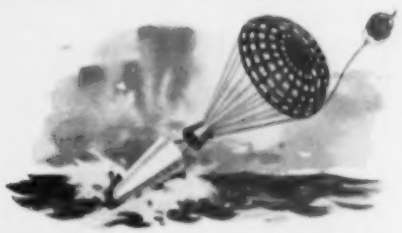

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Copies of this illustration, in full color and suitable for framing, may be obtained by writing the Defense Systems Department, P. O. Box 1487, Syracuse, N. Y.

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AVIATION CORPORATION

Fairchild Reports 1959 Profits

Fairchild Engine & Airplane Corp. reported a $1,515,261 profit for 1959 compared with a $17 million loss the year before, but hewing to the realistic approach to the company's problems which it promised stockholders last year, it did not herald this contrast as representing their solution.

Production of the F-27 turboprop transport and components of the Boeing B-52 bomber fall far short of fully utilizing the Hagerstown, Md., plant, President J. H. Carmichael said.

Fairchild has made an entry into new fields, for example through a contract with Raytheon to manufacture a 60-ft.-diameter radar antenna reflector for use in the Pincushion system to track and identify intercontinental ballistic missiles. But the large volume needed in such new product lines takes a long time to develop, Carmichael said, and is further complicated by competition from other aircraft manufacturers also attempting to utilize excess plant capacity.

Adding to the problems Fairchild faces was the necessity to release 15 F-27s for production before firm contracts had been received from customers. These airplanes have cost $3.8 million so far. Estimate of the additional cost to complete them at present production rates—two a month—is $8.2 million.

These airplanes include prospective reorders from Ozark Air Lines and Quebecair and a new order of 3-5 airplanes from Pacific Western Airlines. Financing problems are the prime reason for delay of the orders.

Besides pushing sales of the F-27, Carmichael called broadening the base of the company along growth lines a principal objective of the company for 1960. The company is also retaining its interest in the airplane business with company sponsored projects that include:

- **Jet wing** transport study.
- **Catapult-launched** carrier aircraft preliminary design.
- **Cargo transport** under investigation to replace its C-119 and C-123.
- **V/STOL vehicle** under preliminary design to replace a number of Army helicopters and aircraft now in service.

In its diversification efforts, Fairchild is experimenting with or producing:

- **Plastic compressor blades** for jet engines, under development for Allison Division of General Motors and Pratt & Whitney Aircraft.
- **Aluminum boats,** including several 14-ft. boats built for Sears, Roebuck & Co. under a program that contemplates Fairchild becoming the sole source of aluminum boats for Sears.

Comparable financial results for Fairchild show sales of $114,651,162 in 1959 and $148,851,787 for 1958. Backlog dropped from $135 million to $76 million in 1959, but working capital rose from $6,071,789 to $13,228,614.

Shot Put Launch

Washington—Project Echo inflatable sphere modified to avoid structural failures that developed during earlier flight tests has been fired successfully by National Aeronautics and Space Administration in a suborbital Shot Put flight.

Sphere launched from Wallops Station, Va., in the fourth Shot Put test was perforated with 240 pinholes. Perforations are oriented to allow residual air to escape when the 100 ft. sphere is folded into its launch container. Amount of residual air left affects the rate of inflation in space, and NASA wants to keep the rate down to avoid structural failure.

Since the perforations appear to have solved earlier problems encountered with the sphere, NASA plans to launch it into a 900-mi. Project Echo orbit covering the earth between 50 deg. north and south latitudes within the next few weeks using Thor-Delta launch vehicles. Two subsequent Thor-Delta launches will put Echo spheres into polar orbits.

GE Reorganizing Electronics Groups

New York—Organizational realignment of General Electric's defense and electronics business was announced last week in the latest in a series of corporate shifts.

Under the realignment, the former Electronic, Atomic and Defense Systems Group becomes the Electronic and Flight Systems Group, continuing under group executive and Vice President C. W. LaPierre.

The new name reflects the fact that the group's activities include non-defense products, such as jet engines for civil aircraft and space programs for the National Aeronautics and Space Administration. Change also reflects GE's recent action in transferring the Hanford Atomic Products and the Atomic Equipment Power departments out of LaPierre's group and into the Electric Utility Group (AW Mar. 14, p. 37).

In last week's action, GE also made the following transfers:

- **Industrial Electronics Division,** from LaPierre's group to the company's Industrial Group, headed by Vice President Arthur Vinson.
- **Communication Products** Department, formerly a member of the Industrial Electronics Division, joins the Defense Electronics Division. Move is expected to strengthen GE in bidding for military communications programs.

In another recent reorganization move, GE merged its Jet Engine Department and its Production Engine Department, both at Evendale, Ohio, into a single Large Jet Engine Department headed by Neil Firestone, former manager of the Production Engine Department. Donald Berkey, former manager of the Jet Engine Department, becomes manager of engineering for the new combined department.

The new Electronic and Flight Systems Group now includes the Defense Electronics Division, Syracuse, N. Y.; the Electronic Components Division, Owensboro, Ky.; Flight Propulsion Division, Evendale, and the Aircraft Nuclear Propulsion Department, of Evendale, formerly a part of the recently dissolved Atomic Products Division (AW Mar. 14, p. 37).

News Digest

Sputnik III decayed Apr. 6 between 2:45 a.m. and 4:45 a.m., ending an orbital period that started May 15, 1958. Decay occurred on last half of its 10,035th earth circuit, or first half of the 10,036 pass.

Second nuclear submarine, the Patrick Henry, was scheduled for commissioning last week at General Dynamics' Electric Boat Division, Groton, Conn. The sub will join her sister ship, the Polaris-equipped George Washington (see p. 87), for sea trials.

Advanced Research Projects Agency was scheduled to brief the President's scientific adviser, Dr. George Kistiakowsky, late last week on the results to date of ARPA ballistic missile/space defense efforts, including the Guide Line Identification Program for Anti-Missile Research (Glipar) program (see p. 31).

House Committee on Science and Astronautics last week approved a subcommittee recommendation to liberalize the patent section of the National Aeronautics and Space Administration (AW Mar. 14, p. 35). New patent section is similar to changes requested by the Administration in that patent rights are left to industry in most cases. Government, however, is required to obtain royalty-free license on patents produced under research and development contracts.

Soviets to Press for Early Bilateral Date

Russians make formal bid to open talks with U.S.; expected to push for New York run in near future.

By L. L. Doty

Washington—Soviet Union, having made its first formal bid earlier this month to open talks on an exchange of air routes with the U.S., is expected to press hard for an early inaugural date of Moscow-New York scheduled services.

Climate for the beginning of negotiations between the two countries on a bilateral air transport agreement appears to be good. Russia's state-owned airline, Aeroflot, now satisfied that its Tu-114 long-range turboprop transport is operationally ready to match or surpass the best aircraft in U.S. airline inventories, wants to start service promptly.

Pan American World Airways—with an eye on the four West European carriers already operating into Moscow with turbine equipment, particularly Sabena Belgian Airlines which is offering onestop New York-Moscow service with Boeing 707 turbojets—is equally eager to launch its scheduled service into Russia provided, of course, it has U.S. sanction.

Nevertheless, most observers here say that it may be a minimum of six-to-eight months before the reciprocal services begin. They point to the British-Soviet bilateral agreement which was originally signed in London on Dec. 19, 1957 (AW Dec. 30, 1957, p. 34) and was renegotiated last spring (AW Apr. 6, 1959, p. 45) before actual service began in May (June 1, p. 52). Here are the major reasons given for the probable delays:

- **In their formal bid to open** talks, received by the State Department on Apr. 1, the Russians suggested either this month or next as a convenient time to begin negotiation sessions. State Department officials say that, because of a heavy agenda throughout the spring months, the U. S. probably will not be in a position to begin talks before this June.
- **Negotiations may be stretched** out beyond normal periods of time because the U. S. will insist upon a Bermuda-type agreement whereas Russia, in all prior bilateral agreements with countries outside the Soviet sphere of influence, has assiduously evaded Bermuda principles.
- **Since Aeroflot is not** a member of either International Air Transport Assn. (IATA) nor the International Civil Aviation Organization, basic bilateral agreement will, by necessity, be supplemented by annex agreements which will set operating and airworthiness standards, air traffic procedures and tariff and traffic principles.

The Russian proposal that bilateral talks be opened is the first response to similar offers made by the U. S. since a formal note was sent to the Soviets by the State Department in October, 1958. Prior to that time, the U. S. had not been eager to enter into any bargaining until it was prepared to cope with the technical problems that will inevitably present themselves in such negotiations.

Prior to the note, Russia consistently prodded the U. S. for some action and, on one occasion, Premier Nikita Khrushchev tweaked the U. S. ambassador in Moscow for failure to push bilateral negotiations (AW Sept. 15, 1958, p. 41). Since the October note, however, the Soviet Union has been virtually silent on the subject of a bilateral.

Speculation has been strong that the Russians would delay formal talks until they were certain that the Tu-114 turboprop transport, which has been flying for almost three years, was ready to perform scheduled service on the long-haul New York-Moscow route. The Tu-114s are now slated for regular trans-Siberian service this spring after several delays beyond last fall's target date (AW Mar. 28, p. 52). They are also now earmarked for the U. S. service.

As matters now stand, there is small likelihood that the two countries will fail to reach a mutually satisfactory agreement on a bilateral. Aeroflot wants to continue its present expansion program which already has taken the carrier into 23 capitals of Europe, Asia and Africa and resulted in commercial cooperation contracts with 30 foreign air carriers.

Commercial interests are the leading reasons behind the U. S. desire to enter the New York-Moscow market. Competition among the Western airlines serving Moscow is already keen, and four of the carriers, looking toward lucrative U. S.-connecting traffic, are in the process of placing their first-line equipment into service on the route.

Sabena Belgian Airlines, hoping to lure the bulk of the expected 10,000 U. S. visitors to Moscow this tourist season with its Boeing 707 turbojet service, began once-a-week jet schedules between New York and Moscow with a 1 hr. 15 min. layover in Brussels.

Earlier this month, British European Airways inaugurated de Havilland Comet 4B service between London and Moscow, and Air France is scheduled to begin Sud Caravelle jet flights from Paris into Moscow later this month. Scandinavian Airlines System also will begin Caravelle service this month.

At the same time, Aeroflot plans to double the number of turbojet and turboprop transports operating on both domestic and international routes during 1960. The carrier said that turbine-powered equipment will operate on "almost all" its international routes this summer. Earlier this month Aeroflot placed the Il-18 turboprop transport into service on routes from Moscow to Peking, East Berlin, Vienna, Stockholm and Helsinki. The Tu-104 turbojet transport serves routes from Moscow to such other European capitals as Paris, Amsterdam, Brussels and London.

Since Aeroflot is not a member of ICAO, operating and technical issues may loom as the major obstacles toward reaching a final agreement. Federal Aviation Agency will not partici-

Proximity Warning Hope

Recent tests indicate that the addition of a small avionic adaptor can enable existing airborne weather radar to detect other aircraft at ranges of up to 10 mi. and provide an automatic alarm for the pilot.

The development is the result of almost two years of effort and flight tests by Radio Corp. of America and United Air Lines.

Additional avionic equipment involved occupies only a ½-ATR-size case, probably will sell for under $10,000. Radarscope will display location of all intruders in the forward area and a cursor-line showing bearing to intruder.

pate in the basic talks, in which the essential terms of the bilateral are discussed. However, the agency will handle all negotiations on a technical annex to the agreement covering all matters pertaining to navigation, traffic control and the airworthiness of the aircraft.

In the British agreement, the technical annex specified that "in principle . . . the standards and codes established or recommended by the International Civil Aviation Organization shall be adopted." In this connection, U. S. Civil Aeronautics Board regulations require that all aircraft registered under the laws of a country not a member of ICAO "may be navigated in the U. S. subject to the same rules, conditions and limitations applicable in the case of aircraft of ICAO member states."

All air traffic control issues were settled in the technical annex in the British-Russian agreement, and the FAA does not anticipate any serious problems in this respect. A spokesman for the agency told AVIATION WEEK that the Russians are known to rely heavily on low frequency beacons and radar for navigation and noted that GCA is available at Moscow's Vnukovo Airport. ILS at the airport, which is incompatible with that used by the U. S., is being replaced with ILS equipment recently purchased by the Soviets in England.

In the British-Russian agreement, commercial aspects of the bilateral agreement were negotiated between British European Airways, the chosen British carrier, and Aeroflot. These negotiations covered such areas as accounting and financial arrangements, traffic handling, ground handling of aircraft and sale of seats. Capacity, according to the bilateral, "shall be closely related to the estimated requirements of air traffic between London and Moscow."

Since Aeroflot is not a member of IATA, rate and fare levels were set by the two airlines and then approved by their respective governments.

Similar agreements will be worked out between Aeroflot and Pan American, only U. S. carrier certificated to operate the route, by an annex to the bilateral agreement.

Most observers here feel that a straight New York-Moscow route will be settled upon in the first round of negotiations. Any proposals for fifth freedom rights made by the U. S. are likely to be flatly rejected by the Russians since no country has yet been able to obtain rights to fly beyond Moscow.

In addition, the Russians probably will balk at any moves made by the U. S. to inject a multiple designation provision in the agreement which would permit it to certify more than one carrier on the route.

Airlines Draft Plan for New Bid To Gain More MATS Business

By Robert H. Cook

Washington—Scheduled airlines are regrouping their arguments for a greater share of Air Force's Military Air Transport Services' cargo and passenger business following their apparent defeat during hearings of a House Armed Services Subcommittee (AW Mar. 28, p. 38).

Although the industry's key witnesses have failed to impress the subcommittee, which reportedly has recommended almost $300 million for modernization of MATS equipment in Fiscal 1961, the airlines are expected to stage a last ditch stand before a Senate Appropriation Subcommittee for defense.

However, any belief that the airlines will fare appreciably better before the Senate subcommittee is fading.

A tacit agreement between the House and Senate subcommittees on MATS' need to modernize its obsolescent aircraft fleet apparently has been reached, and airline demands for a cutback in MATS' daily flight utilization rate is a secondary issue.

Cost of achieving the modernization is the key factor in the airlift hearings. MATS has made a strong case for its equipment needs and the necessity for a five-hour daily utilization rate for training purposes. Acquisition of cargo versions of existing turbine-powered aircraft by MATS (AW Apr. 4, p. 42) probably would result in a declining need for commercial augmentation as the new aircraft are phased in.

At the same time, MATS now enjoys substantially low cargo rates as a result of Air Force procurement of airlift by competitive bids. Cutting the MATS utilization rate, or changing from competitive bidding to cargo rate formulas as suggested by the airlines, could triple the present cost of procuring commercial airlift for MATS. Members of the House subcommittee estimated a transfer of all routine MATS traffic to commercial carriers could boost MATS expenses by an additional $1 billion within the next five years.

Meanwhile, the House subcommittee is expected to get a joint Air Force-Defense Department critique of the recent Big Slam airlift exercise (AW Apr. 4, p. 50) by Apr. 20. Study of airlift testimony given thus far, plus the MATS Big Slam exercise, will be the basis for recommended airlift legislation later this year.

The additional cargo aircraft probably would include 50 cargo versions of the Douglas DC-8 or Boeing 707 turbojet transports and 50 Lockheed Super Hercules C-130 turboprop aircraft equipped with additional fuel tanks for long-range operations.

Cost of procuring commercial airlift for MATS was a major issue last week as the subcommittee heard testimony from Stuart G. Tipton, president of the Air Transport Assn., and Chan Gurney, vice chairman of the CAB.

Tipton took particular issue with subcommittee cost estimates for transferring routine MATS traffic to commercial airlines and recommended a change in the present system of competitive bidding for MATS contracts. The subcommittee estimated that the transfer of all MATS traffic at the lowest available commercial fares would cost MATS an additional $391.3 million a year. MATS is spending approximately $79 million for commercial airlift in Fiscal 1960. Rates suggested last year by the CAB would cost the military $279.4 million for airlift as compared with $198.3 million for which it could be shipped under the bidding system, according to the subcommittee.

Tipton said ATA has been unsuccessful in obtaining a detailed breakdown of MATS expenses, but that it believed the $180 million earmarked for MATS training this year failed to include personnel costs that could increase the actual outlay to almost $400 million. ATA studies show that the cost to move all of MATS routine traffic by commercial carrier this fiscal year under the lowest passenger fares and cargo tariffs on file with the CAB would have been a total of $266 million for passengers and $148 million for cargo.

Committee members, in turn, emphasized the low prices MATS is getting under its competitive bidding as compared with the lowest published fares. In the case of a TWA contract with MATS, passengers were carried from the East Coast of the U. S. to

Tunner to Retire

Washington—Air Force announced last week that Lt. Gen. William H. Tunner, commander of the Military Air Transport Service and spearhead of MATS' re-equipment drive, will retire late this spring at his own request after 32 years of service.

Gen. Tunner stepped in as MATS commander in July, 1958, following tours as USAF deputy chief of staff for operations and as commander of the U. S. Air Forces in Europe. In 1948-49, he managed the combined USAF-Royal Air Force Berlin airlift that supplied that city during the Soviet blockade.

Frankfurt, Germany at a cost of $79 each as compared with the lowest economy fare for this distance of $255, they said.

Tipton cited the case as an example of the government using its "tremendous power to drive prices down" to a point where many operators either were unable to earn a profit or experienced too small a profit to encourage the purchase of new flight equipment. He added that airlines continued to bid on such contracts to keep flight equipment busy and that fares lower than $253 for Frankfurt could be realized if the airlines obtained a higher volume of MATS traffic.

Gurney backed Tipton's stand on air cargo and said that present rates have failed to increase cargo airlift and are too high but that they are "as low as we can get them and still keep some cargo carriers in being."

"The question now boils down to which is more important to national defense, the lowest cost for supplemental airlift, or more modern aircraft," he said.

Criticizing competitive bidding, Gurney said that the military "is not getting a modern reserve fleet and won't be letting these bids at figures so low there is no profit to buy new planes for such a purpose." Subcommittee members had pointed out earlier that a recent $39 million MATS airlift contract would have cost about $136 million if contracted under CAB-suggested cargo rates.

In response to further questioning, Gurney said that he sees no opportunity for the airline industry to gain a new all-cargo aircraft unless it is developed by the military but that he would still recommend that MATS channel its routine traffic to the airlines which would have to carry it on modified passenger planes. Lower rates could still be realized with this interim equipment, Gurney said, if the airlines could be assured of a larger share of MATS traffic.

John J. Allen, under secretary of the Department of Commerce, told the subcommittee that, while manufacturers are prepared to produce a cargo aircraft, orders for the aircraft hinge largely upon the question of who will carry military cargo. "Obviously," he said, "there is so much of this cargo and no more. If the military is going to carry it, the private carriers are not going to invest. On the other hand, if private carriers are assured of a portion of this traffic, I think they will obtain the aircraft to carry it."

Turbofan Hercules Specifications Revealed

Design for a swept wing, swept empennage version of the Lockheed Super Hercules transport, called the GL 207-42 (AW Mar. 28, p. 38), will incorporate a more powerful version of Pratt & Whitney's JT3D turbofan engine—the JT3D-11 developing 22,000 lb. thrust. Aircraft also will utilize the cockpit, fuselage nose and center sections, and system concepts of the C-130B Hercules, Aviation Week has learned. The fuselage, 280 in. longer than that of the C-130B, would be refaired into a low-drag configuration in the aft end.

GL 207-42 Data

Specifications:	
Span	160 ft.
Length	126 ft.
Height, vertical stabilizer	38 ft.
Wing area	3,000 sq.ft.
Cargo floor height	50 in.
Minimum cargo compartment size	67 ft. long, plus 8 ft. ramp 10.25 ft. wide 9.1 ft. high
Side cargo door	6.5 ft. wide x 9 ft. high
Aft cargo door	10.25 ft. wide x 9.1 ft. high
Engines	Four Pratt & Whitney JT3D-11s developing 22,000 lb. thrust each at takeoff
Cost	About $4.9 million
Performance:	
Maximum gross weight	250,000 lb.
Maximum landing weight	202,000 lb.
Zero fuel weight	191,000 lb.
Equipped weight empty	114,400 lb.
Structural payload limits	
At 2,150 naut. mi.	77,000 lb. (maximum)
At 4,100 naut. mi. (transatlantic)	41,000 lb.
At 5,500 naut. mi. (transpacific)	20,000 lb.
Maximum cruise at 20,000 ft., maximum gross weight	490 kt.
Long range cruise at maximum gross weight	440 kt.
Four engine rate of climb at sea level, standard day, maximum gross weight	4,500 fpm.
Three engine rate of climb at sea level, takeoff flaps, gear up, maximum gross weight	More than 1,000 fpm.
Landing ground roll after clearing 50 ft. obstacle	4,000 ft.
Takeoff ground roll to clear 50 ft. obstacle	3,800 ft.
Turning radius	Less than 150 ft.
First flight	24 mos. from contract go-ahead
First delivery	32 mos. from contract go-ahead
Squadron strength delivery	38 mos. from contract go-ahead

All payload and range figures computed in accordance with military specification C-5011A.

Air France 707-320 Loses Cabin Pressure

Paris—Air France officials are investigating the cause of a sudden loss of cabin pressure aboard a Boeing 707-320 Intercontinental shortly after takeoff from Orly Airport to New York.

Accident was further complicated by malfunction of the emergency fuel evacuation system. Unable to jettison the fuel the pilot had to postpone his emergency landing nearly four hours while he circled Orly Airport.

Company officials declined comment pending further study of the incident. Reliable reports, however, indicate loss of pressurization took place 15 min. after takeoff at an altitude of roughly 20,000 ft. Pilot immediately dived the aircraft to 3,000 ft.

One crew member said the cabin filled with white smoke. A system which automatically ejects a concealed oxygen mask in front of each passenger during loss of pressurization reportedly functioned perfectly.

Many of the 52 passengers aboard had to be helped in adjusting the masks. One crew member fainted from loss of oxygen while aiding passengers with their masks.

Flight Engineers Seek Change In Fueling System of Electra

New York—Flight Engineers International Assn. has recommended to Federal Aviation Agency that a low-pressure valve or other device be installed on the Lockheed Electra turboprop to eliminate what the engineers consider a fueling problem with the airplane.

According to T. L. Bynum, an Eastern Air Lines flight engineer instructor and an accident investigator for FEIA, the single-point fueling system on the Electra can cause structural damage to the wing of the aircraft if pressures built up in the fueling process are not properly relieved. Eastern, Bynum told a meeting of the International Technical Institute of Flight Engineers here last week, experienced a rupture of an Electra fuel tank from this cause which resulted in wing damage. In the incident, which occurred at New York International Airport last fall, the fueling valve failed to close because of foreign matter caught in it, and high pressure ruptured the tank when it had been filled.

In this instance the wing damage was spotted, but Bynum said it would be possible for such damage to remain undetected and later on "something might happen." Metal in the Electra's wing will not distort noticeably, he said, until it is near the breaking point.

Other shortcomings of the Electra, according to Bynum, include insufficient backup for its electrical system. Flight instruments are electrically powered, Bynum said, and since the backup batteries are good for only 25 or 30 min. of use, failure of the electrical system could result in catastrophe. The flight engineers have recommended that an alternate system, such as a generator which could be lowered into the airstream, be provided as a backup.

Another problem has been the effect of hard landings on the Electra, Bynum reported. Often these produce a nacelle droop which might reach 13½ deg. Another effect has been damage to the lower wing skin and distortion of the wing ribs.

Regarding the Electra's autopilot, Bynum said its rate of control movement was at one time so great that it jarred the aircraft. Sensitivity of the unit has since been decreased, he said, to the point where a beam coupler approach technique could not be used. The Electra's autopilot, he pointed out, is not now being used at all.

Another recommendation of the flight engineers is to install a heat rise warning device because load centers such as electrical and hydraulic equipment are now open to each other, without a fireproof lining between them, Bynum said.

In connection with the fueling problem, Bynum said American Airlines has installed a relief valve in the wing tanks of its Electras. Eastern, according to Bynum, requires the fuel tank caps on top of the wings to be removed when its Electras are being fueled.

Poor Planning Charged To Aeroflot Officials

Moscow—Aeroflot, the Soviet state-owned airline, is losing substantial amounts of passenger and cargo business because of planning errors by Moscow bureaucrats who fail to understand changing service needs at the local level, according to a Russian airport director.

I. Romatovsky, chief of the Gorky Airport, writing in the Aeroflot magazine, said that inability to get prompt action from headquarters on service change requests is particularly harmful during peak traffic periods.

On one occasion, Romatovsky complained, Moscow refused to permit Gorky to increase its flights to Caucasus resorts from four times weekly to daily, although aircraft and crews were available and passengers were being turned away for lack of space. Gorky officials' proposal to offer more flights to Moscow at reduced fares also was rejected despite the fact that trains between the two cities were unable to handle the passenger load, according to Romatovsky.

About the same time, the Sverdlovsk and Bykovo (Moscow) airports "systematically refused to handle transit cargo," the airport director charged, "although almost all the cargo we send in an easterly or westerly direction can only reach its destination through these two fields. Obviously the disinclination of the Bykovo and Sverdlovsk airport directors to be bothered with transit cargo played the main role here."

The Gorky airport director said he frequently receives requests from distant customers of a near-by plant for air shipment of certain chemicals. But, he said, most of the chemical items ordered are not listed in the current instructions for transportation of class cargo by air.

"Thus in each individual case we have to ask Moscow's permission to handle the order, entailing considerable delay. Furthermore, our requests are frequently turned down."

Romatovsky declared that aircraft utilization is curtailed because transports assigned to routes out of Gorky stop overnight at the opposite terminal rather than flying back the same day with a different crew. He expressed hope that Moscow's planning errors would be eliminated in 1960 and that headquarters personnel would cooperate in dealing with local suggestions.

ALPA Plans Hearing On Pilot Expulsions

Washington—Leaders of an Air Line Pilots Assn. group that refused to pay an ALPA-levied assessment for Eastern and Capital airlines pilots idled by strikes of other labor groups over a year ago are scheduled to face expulsion trials this week before a special union hearing board.

The 20 pilots on trial also are awaiting an appeal from a court decision which held last July that ALPA is legally authorized to request such assessments and that neither its president, Clarence Sayen, nor treasurer, Don J. Smith, is guilty of fraud as the dissident group charged (AW July 20, p. 37).

Basis of the court case, filed by James R. Eads, of Trans World Airlines and Lawrence Shapiro, of United Air Lines (AW Mar. 9, 1959, p. 328), was that the assessments amounting to more than $1.1 million were for "unemployment" benefits beyond the union's authority.

The July court decision followed a temporary injunction against the ALPA assessment won by the two objecting pilots, who said that their faction, known as the Air Line Pilots Group, represented nearly 80% of ALPA's membership. The court decreed that each ALPA member was bound to pay the assessment, which the Shapiro-Eads group estimated cost pilots an average of $120.

While each of the 20 men ordered to appear before the union hearing board complied with the court ruling, 157 other ALPA members refused to pay the levy and were later expelled from the union.

Eads and Shapiro contend that expulsion of these men is illegal since the new Landrum-Griffin labor bill provides that a union member can only be expelled from membership without a hearing for non-payment of dues. Assessments levied by ALPA are not properly considered dues, the dissenting pilots claim, and the Department of Labor has been asked for an interpretation on this point.

All of the 20 men accused by ALPA of organizing the fight against assessment payments already have been cleared by their local executive committees. Shapiro and Eads charge that, under the union constitution and by-laws, these decisions cannot be revoked.

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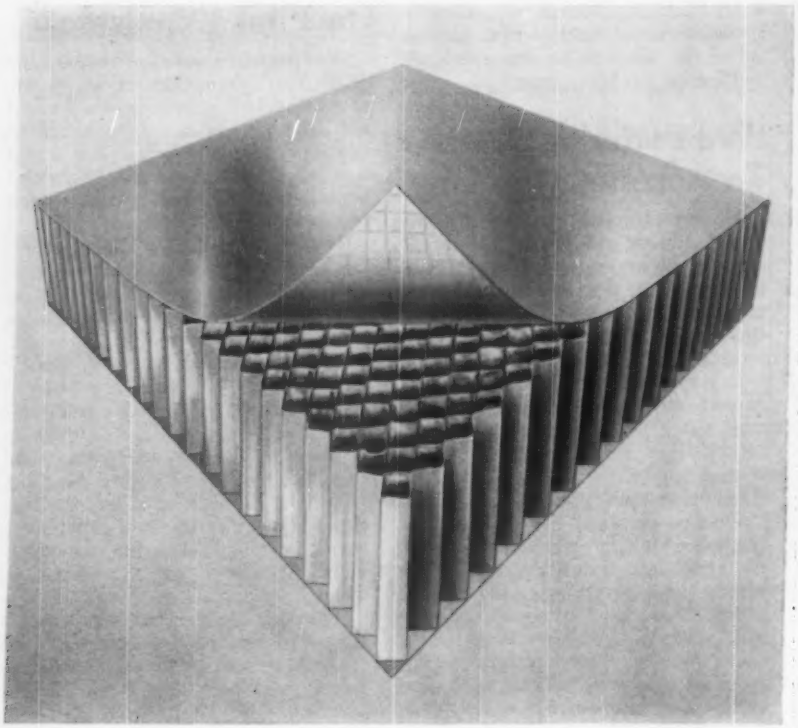

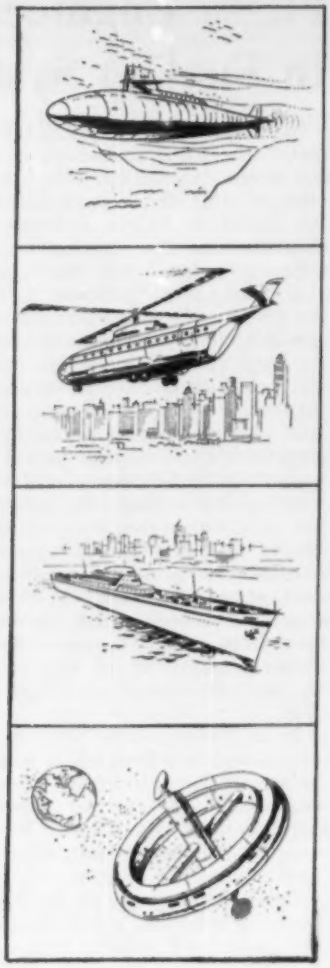

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EAST GERMAN Deutsche Lufthansa Il-14P stands on the apron at Leipzig Airport. Plane is the workhorse of the East German airline fleet and currently serves both internal and international routes. Turbine-powered Il-18s and Type 152s will augment the fleet.

Il-18 May Bolster East German Airline

By David A. Anderton

Berlin—East Germany's Deutsche Lufthansa is counting on two new transports to help it meet the goal established by the country's seven-year plan for expansion of industry and commerce.

The transports are Russia's Ilyushin Il-18 turboprop airliner, and East Germany's own Type 152 turbojet aircraft.

The goal is to carry at least five times as many passengers in 1965 as the airline did in 1958, first and base year of the plan. Available statistics are few in number, but they emphasize that East Germany runs a small airline. In 1958, a total of 103,858 passengers was carried. Last year that number increased to 168,000.

Passenger-mile figures are even more elusive, and are available only as index numbers based on 1956, which is represented by 100. Since 1956 was the starting year for the airline, the growth looks phenomenal. Examples: for 1957, the index was 361; for 1958, it was 676 and for 1959 the index reached 861, almost nine times the number of passenger-miles flown in 1956.

East Germany is a relatively small, highly industrialized country with a population of about 17.4 million people and a land area of 41,600 sq. mi. The country stretches only 300 mi. from north to south, and no point is more than 200 mi. from the capital in Berlin.

As in most European countries, the airline has to compete internally with the government's railroad services. In East Germany, trains still carry the majority of the traveling public even though the service leaves much to be desired in speed, frequency and comfort.

Excellent East German autobahns and a well-developed highway system also drain off some of the prospective customers for Lufthansa, particularly now that more and more automobiles are available for purchase.

Point-to-point times in such a network of transportation leave little to choose from in means of travel. Increased flight frequency is a necessity, otherwise the prospective airline customer takes the train rather than wait another day for the next airplane.

That is probably the major reason why less than 1% of the total population was carried by Deutsche Lufthansa last year, compared with about 25% of the U.S. population that emplaned.

East German flight operations are handled by two theoretically separate companies working at the same address in Berlin: Deutsche Lufthansa (DLH) and Interflug.

DLH is the scheduled airline, and flies internal and international services, operates an air taxi system and an aerial survey and photography unit. Its name, insignia and blue-and-yellow color scheme are identical with those of the West German carrier. Only the detail markings of of the airplanes differ from those of the West German Deutsche Lufthansa.

The airline began operations in 1956 and carried 34,278 passengers during the next year. Now it flies to the capital cities of the Soviet-bloc countries, including Moscow, Warsaw, Budapest, Bucharest, Prague and Sofia. It has commercial or pool agreements with 20

Data Assessment

One of the toughest problems in assessing the operations of East Germany's Lufthansa is to determine which publicly announced figures are correct.

One source—a travel folder issued by the Society for Cultural Relations with Foreign Countries—says that 200,000 passengers flew with the airline in 1958. But a technical article in Deutsche Flugtechnik, written by a Berlin engineer, says 103,858 passengers flew with the airline in 1958.

The same tourist folder gives the length of the new runway at Berlin-Schoenfeld as 9,580 ft., whereas the same technical article gives the length as 11,800 ft.

For this report, any obvious conflict has been resolved by assuming the more logical source as the correct one. In the cases cited above, the technical article was used in preference to the tourist folder.

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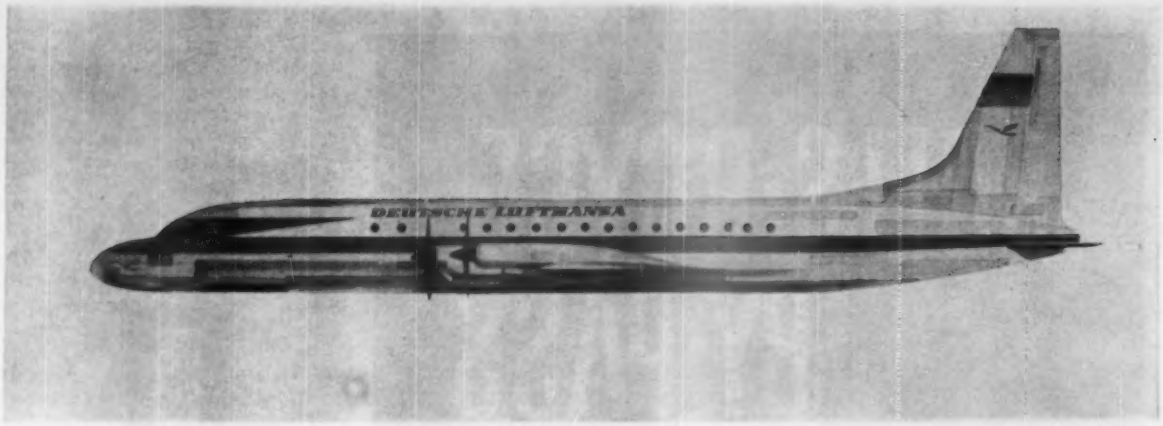


EAST GERMAN DEUTSCHE LUFTHANSA will begin Il-18 turboprop transport service this year between Berlin and Moscow. Airline's name, insignia and blue and yellow color scheme are identical with those of the West German carrier except for detail markings.

foreign companies, both Eastern and Western.

Internal services are flown to Leipzig, Dresden, Barth, Eisenach, Erfurt and Karl-Marx-Stadt, with Berlin the hub of the route network.

Fleet consists of about 50 airplanes. Workhorse of the operation currently is the Ilyushin-designed, East German-built Il-14P twin-engine transport. Some Russian-built Antonov An-2 biplanes are used on local service runs, and the air taxi service uses Czech-built Aero 145 light transports. To this fleet will be added the Il-18 "Moscow" turboprop transport and the turbojet Type 152.

Interflug is a subsidiary company, founded in September, 1958, to handle special flights, such as vacation trips, and connections with the Leipzig Technical Fair. The company makes international flights on a nonscheduled or charter basis. The fleet consists only of Il-14P twin-engine transports.

Air taxi service started last year as an experiment, probably along the lines of the Czech service, and is now an accepted operation. There are about two dozen landing sites for the system in addition to the "big city" airports, probably cleared strips near major industrial installations.

There is no indication that helicopters are being operated by either company, although two unmarked Mi-4s were seen at Schoenefeld Airport near Berlin recently.

Official sources say deliveries of the Il-18 fleet were planned for the first quarter of this year. Number of planes to be delivered has not been announced, but the Czech airline, Ceskoslovenske Aerolinie, is taking delivery on three, a figure that has also been the established "fleet" quantity for the Russian Tupolev Tu-104s delivered outside. Three in the fleet would guarantee two available for service, with the third on standby or in overhaul.

First use of the Il-18 will be on the Berlin-Moscow run, in a pooled operation with Aeroflot, the Russian airline. Flight time between the two capitals is about 2 hr. 40 min. at the normal 400-mph. cruising speed of the Ilyushin plane. The East Germans say at least two round trips per day will be made with the airplane.

The big transports will differ in interior layout from those now in service with Aeroflot and those scheduled to be delivered to the Czechs. Normal configuration will be 84 seats, with the possibility of adding five more to bring the tourist configuration up to 89. Layout is the now-standard five-abreast seating, with the two seats left of the aisle.

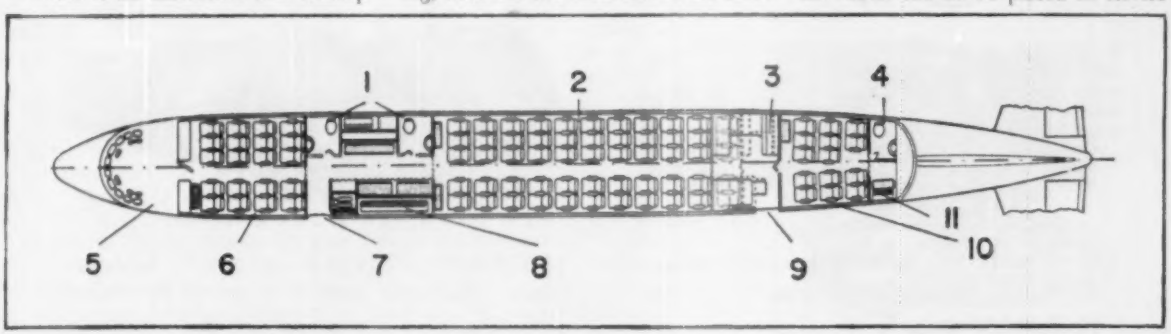
The cabin is subdivided into six major sections aft of the crew compartment: 20-seat forward cabin; service section with entrance, wardrobe and toilets; main cabin with either 50 or 55 seats depending on configuration; galley; 14-place passenger cabin; and finally the rear section with one toilet and a wardrobe.

Major effect of the availability of the Il-18s on international runs will be to free a big portion of the Il-14 fleet for internal routes. This means that frequencies can be increased, but it also means that some routes now flown by the An-2 will be served by Il-14s. This is roughly comparable to the transition some of the American carriers made in the early '30s when they replaced their Curtiss Condors with Douglas DC-2s.

Frequency of East German operations from November to March is low. Berlin-Dresden and Berlin-Leipzig runs are made twice daily four days a week, and four times daily two days a week, with no flights on Sunday.

The airline says summer frequencies will be sharply increased, and cites the Berlin-Leipzig and Berlin-Dresden runs as examples. These routes will be served eight times per day.

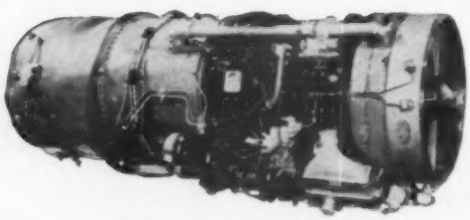
Dresden-Erfurt will be again served with Il-14s, says the company, so that the An-2s can all be placed in service



EAST GERMAN IL-18 will seat 84 passengers in three cabins (89 in tourist configuration). Aeroflot Il-18s seat 80 in two cabins (AW Aug. 3, p. 42). East German layout: 1—toilets; 2—middle cabin (50-55); 3—galley; 4—toilet; 5—flight deck; 6—forward cabin (20); 7—forward entrance; 8—wardrobe; 9—aft entrance; 10—aft cabin (14); 11—wardrobe.

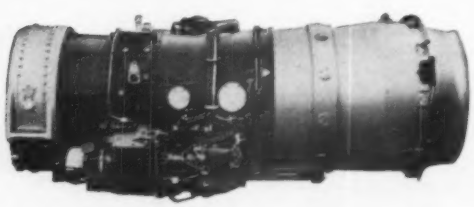
ROLLS-ROYCE BY-PASS JETS

designed for maximum operating economy

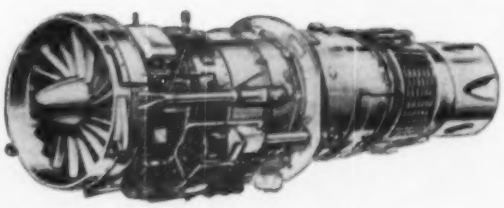


Conway by-pass jets will enter service this year in Boeing 707-420 and Douglas DC.8 jet airliners at 17,500 lb. guaranteed minimum thrust. The Civil Conway is being developed to powers over 20,000 lb. thrust with improved fuel consumption and will power the Vickers VC.10.

THE BY-PASS PRINCIPLE PROVED BY THE CONWAY IS NOW GENERALLY ACCEPTED AS THE CORRECT FORMULA FOR JET TRANSPORTS



The RB. 141 of 15,000 lb. guaranteed minimum thrust will power later versions of the Sud Aviation Caravelle.



The RB. 163 of 9,850 lb. guaranteed minimum thrust has been chosen to power the Airco DH.121.

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between Karl-Marx-Stadt and Berlin.

Seats offered from Leipzig, Dresden and Eisenach to Barth, a Baltic Sea resort town, will be at least doubled. Special vacation flights for groups of workers will be increased, and possibly extended to some foreign countries.

The Il-18 is scheduled to be used also for vacation trips planned by the East German travel bureau, by various tourist and vacation committees and by workers' groups which arrange fixed-price recreation trips. The service will be aimed particularly at the Balkan area.

The airline expects to triple at least the number of tourists carried on these special flights during this summer. For the first time, Sunday flights will be scheduled, and Barth will get year-round service on weekdays. Sightseeing flights are to be increased, using some of the available Il-14s.

The emphasis on vacation flights shows that the management of the airline realizes where its biggest increment of passengers will originate. Internal business traffic is not expected to increase greatly because of the competition from other transportation. But attractive prices for group travel will provide a big increase in the number of passengers carried and passenger-miles flown, and those statistics will look good at the end of the year or of the plan.

East German Lufthansa is beginning to promote air freight in connection with its forwarding company, VEB Deutrans of Berlin. Specific rate structure or other information is not available generally, and the only quoted figures are given in a folder which lists two typical examples of savings achieved by using air freight.

One of these is the shipment of 100 office machines from Berlin to Cairo. Total cost by rail and sea freight from Berlin via Genoa to Cairo is 7,571 Deutschmarks, including insurance. Same machines sent by air freight would cost the shipper 6,130 DM, a saving of about 20%. There is no point in trying to compare these costs with equivalent dollar values, because the official rates of exchange are rigged and meaningless, at about two East German marks to the dollar. For tourists and Technical Fair visitors, the rate is at par with the West German mark, about four to the dollar.

The same difficulty of cost comparison comes up in passenger tickets. Round-trip fares from points outside the country to Leipzig during the Fair work out at about 10 cents per mile, using the official Deutsche Lufthansa table to compute fares in U.S. dollars. Internal fares, such as between Berlin and Leipzig, work out to about seven cents per mile, using the same table.

Coupled with the increase in flight schedules is a building program aimed at modernizing and extending the airports inside East Germany.

Berlin's Schoenefeld airport in the Eastern sector of the city is being enlarged to make it an international airport capable of handling all current jet and turboprop transport traffic. During 1958 there was an average of 60 takeoffs and landings daily at the field.

The runway is being extended to almost 12,000 ft. (including what the Germans call "Stoppflachen," which may be interpreted to mean overrun areas). Width of the runway will be 200 ft. The concrete pavement will take aircraft up to about 350,000 lb. gross weight.

On the north side of the field there is a large construction project, including hangar space and other terminal area facilities, scheduled to be completed by 1962.

Airports at Leipzig and Erfurt will be closed temporarily to traffic because of runway construction this year. This would seem to preclude the eight-times-daily service already announced for those cities, because there are no alternate landing areas nearby.

Facilities at these airports are minimal. Foreign pilots flying into Leipzig for the recent Technical Fair commented that the field had nothing but two beacons for instrument approach; there were no ILS, GCA or VDF systems. Approach procedures for Leipzig are standard for a two-beacon letdown. There are no approach lights ahead of the runway; on a northern approach to Runway 263 there is confusion caused by a row of red lights which look like either obstruction or threshold lights, and turn out to be the latter.

Limits for Leipzig are 2 km. visibility and 100 meters ceiling (1.24 mi. and 328 ft.). for a northern approach, and 3 km. and 300 meters (1.86 mi. and 985 ft.) for the reciprocal heading. These limits are doubled at night.

This observer, scheduled to fly back from Leipzig to Zurich on a normal IFR day for Europe, was surprised to find the airport at Leipzig closed to traffic. Visibility was an estimated half-mile and ceiling probably 400 to 500 ft., apparently above the official limits.

But Deutsche Lufthansa wasn't flying that day. Airline personnel contributed the information that all airports in Europe were closed, but a simple check of the records later proved them misinformed.

An East German fellow-passenger later asked furtively if it was not true that the Western operators were able to fly in much worse weather than this. To the affirmative answer he said, "I thought so. We don't have a very good airline."

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American Schedules Turbofan Retrofits

By Glenn Garrison

New York—American Airlines faces a juggling problem of major proportions in scheduling the conversion of two types of jet transports into turbofan power (AW Nov. 9, p. 43).

The process, expected to begin late this fall, involves three basic operations: conversion of 24 Boeing 707-120s to the turbofan engine; conversion of 10 Boeing 720s to turbofan, and airframe modification of the 120s to provide new features incorporated in the production 720.

American will convert the engines at its Tulsa maintenance base. Boeing will modify the 707-120 airframes. The engine flow is three-cornered, also involving Rohr Aircraft Corp., which builds the nacelles and installs the engines in the power pack.

The airline's present 707-120s are powered with Pratt & Whitney JT3C-6 turbojet engines, which will be designated JT3D-6 after conversion to turbofans. First 10 of the smaller 720s will be equipped with JT3C-7 engines, which will become JT3D-7s after conversion. New turbofan engines will be designated JT3D-1. Turbojet 720 engines are slightly less powerful than their 707-120 counterparts, but after conversion all three engines will be equally powerful.

Frank Kolk, American's director of engineering research and development, said the key to such a scheduling operation is flexibility, and American has built some play into the program.

Here is the timetable as it now appears:

- **American's 26th 707-120** (one was lost in a training crash) is in effect a prototype for the 120B series, and will incorporate the airframe improvements and turbofan engine. It is expected to fly in late May, and will be used for flight tests and certification.
- **First 720 deliveries** start about July and continue for about three months until 10 airplanes are received. These planes will be equipped with the JT3C-7 turbojet engine; the final 15 in American's total 720 order will have JT3D-1 turbofans installed on the production line.
- **Several 120s** will be taken out of service and started back to Boeing around the end of September. Engines will be removed at Seattle and trucked or flown to Tulsa for conversion. Boeing will modify the airframe, installing a wing leading edge glove, leading edge flaps and a redesigned rudder. Big item in the modification is the glove, which will bring the time involved to about a month. Otherwise the time would be only a few days.
- **Spare engines** must be sent to stations around the airline's system. Some engines will go through Tulsa for conversion, while some new engines will go into the schedule beforehand.
- **Converted engines** will move from Tulsa to Rohr's shops in the Seattle area, then over to Boeing for installation on the airplanes.
- **First 707-120B** will go back into service around the end of 1960.
- **First production 720Bs** will be delivered to American in early 1961. By this time, some 720s will be at overhaul time and conversion will take place at Tulsa. Airframes will go through the Boeing plant as did the 707-120 airframes, but the major modification necessary on the 120 will already have been built into the 720 on the production line. Time at Seattle for the 720s therefore will be much less, probably about a week.
- **Convair 600 deliveries** are expected to begin in mid-1961, and the airplane probably will be in service before the final Boeing retrofittings are completed.

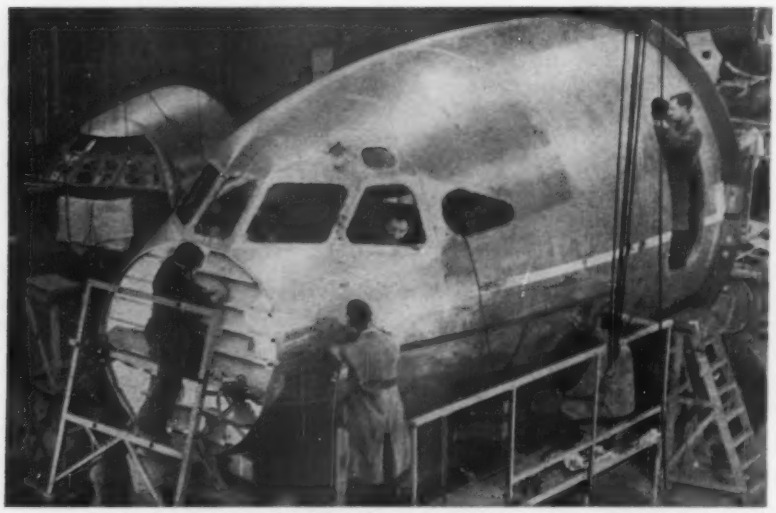
American may coordinate the Boeing airframe deliveries to Seattle to coincide with airframe overhaul times. These are related to engine overhaul times because progressive airframe maintenance is scheduled in terms of units of engine time. Ideally, then, engines would arrive at Tulsa for conversion along with overhaul, and airframe overhaul would be accomplished along with the modifications at Seattle. Boeing may do the overhaul work for American at the same time as the modifications; the matter is under negotiation.

If it doesn't work out so that Boeing does the airframe overhaul or a sizable portion of it, American could take another approach and send an airplane with considerable time remaining until overhaul, powered by nearly run-out engines. With the converted engines installed, the modified plane then could go back into service and phase into the airframe overhaul schedule at Tulsa.

Kolk says the juggling problem is not unique but basically is the same as in scheduling any mixed fleet through an overhaul base. At Tulsa, for example, Douglas DC-7s are more of a problem in this respect than Lockheed Electra turboprops because the DC-7s are not assigned to flights that terminate at a relatively low-density traffic point such as Tulsa. The shorter-haul Electras are. Therefore, DC-7s are ferried in for overhaul whereas an Electra can be scheduled to terminate at Tulsa at overhaul time.

American would have faced a real flight equipment problem this summer, Kolk said, if it had been necessary to withdraw a 707-120 from service for the modification flight testing and certification. Purchase of the 26th airplane solved that problem, cutting the down time by about half.

The above aircraft designations are the manufacturers' and do not represent the numbers American uses for its planes. The airline calls its 707-120 the 707-123, its 720 the 707-023 and its Convair 600 the Convair 990.



First Production DH-121 Nose Section Completed

Work is proceeding on the DH-121 transport at the de Havilland plant at Hatfield, England. Canopy in foreground is that of the first production aircraft scheduled for completion about the end of 1961. Another complete nose section is undergoing pressure tests in one of the Hatfield water tanks.

SHORTLINES

▶ **American Airlines** has signed agreements with a number of trucking companies to provide a combined air-truck freight service that will link 575 medium sized cities with more than 60 points served by American. The agreement provides for a single bill of lading. In the past, shippers have been required to use as many as three. The program, known as "Truckair," also provides for a single-rate tariff rather than a combination of truck and air rates.

▶ **Civil Aeronautics Board** hearing examiner has recommended amendment of Trans Caribbean Airways' certificate of public convenience to include transporting mail over its New York-San Juan route on a non-subsidy basis.

▶ **Czechoslovakian Airlines** (CSA) reports that it plans to begin regular service between Prague and Baghdad, via Budapest and Beirut and to Prague and Rome via Vienna, this month using Soviet-built Il-14 piston-engine transports.

▶ **Eastern Air Lines** is scheduled to begin daily round trip Douglas DC-8 turbojet transport service from New York and San Juan on Apr. 24. Also on Apr. 24, Eastern plans to begin three low-cost round trip flights a day over the same route with Douglas DC-6Bs. One-way fare will be $45. On Fridays, Saturdays and Sundays, a fourth flight will be added until June 1, when all four will operate daily.

▶ **Iberia Air Lines of Spain** is concentrating its U.S. sales efforts this summer on charter services in an effort to offset competition of the turbojet transport services now provided by other carriers into Spain and Europe. Iberia's three Douglas DC-8 turbojet transports will be delivered early next year.

▶ **National Airlines** is scheduled to begin air freight service this week with an all-cargo Lockheed Super-H Constellation between New York and Miami. The airline, which eventually plans to convert all four of its Super-H Constellations to all-cargo configurations, said the initial aircraft should increase the carrier's freight capacity by approximately 1.5 million lb. per month.

▶ **Real Airlines of Brazil** plans to begin once-a-week service from Sao Paulo to Tokyo on June 30 using Lockheed Super-H Constellations. The flights will follow Real's regular Sao Paulo-Los Angeles route, stop overnight and continue on to Tokyo the next day via Honolulu and Wake Island.

AIRLINE OBSERVER

▶ Watch for an order by Iberia Air Lines of Spain for a fleet of Sud Caravelle turbojet transports to serve its European fleet. Iberia officials are now in France studying the aircraft with members of the Spanish Institute of Industry, who will work out financial arrangements if the purchase is made. Meanwhile, Spanish government can be expected to make a decision before the end of the year as to whether state-owned Iberia will join Europe's four-member Air Union (Air France, Alitalia, Lufthansa, and Sabena).

▶ **General Electric Co. may loan or rent its recently purchased Caravelle Mark VII transport powered with GE CJ-805-23 aft-fan engines to a domestic airline to put the aircraft into service in order to get air carrier experience. The airline would receive the aircraft after GE completes its tests.**

▶ Domestic trunkline carriers in February will show one of the largest monthly losses ever recorded by the industry. Early indications are that at least 11 of the 12 trunklines will report heavy deficits for the period, which will have a serious effect on quarterly results since no substantial improvement in earnings during March is indicated.

▶ **Airline common stocks listed on the New York Stock Exchange, already depressed in a weak market, have consistently dipped to new lows during the past two weeks with most analysts attributing the decline to early estimates of lower trunkline earnings in the first quarter. Capital Airlines' stock dropped sharply following its petition to the Civil Aeronautics Board for subsidy, and most airline listings slipped after Federal Aviation Agency announced speed restrictions on the Lockheed Electra turboprop transport (AW Apr. 4, p. 43).**

▶ Soviet Premier Khrushchev has backed away from his spontaneous order for 12 Sud Caravelle turbojet transports during his recent visit to France (AW Apr. 4, p. 58). Terming his earlier statement a "joke," he now says Russia would buy the Caravelle if France buys the Tu-104 turbojet transport.

▶ **Soviet Union and the Republic of Guinea have signed an agreement providing for Soviet technical aid in reconstructing the airport at Conakry, the African nation's capital. Airport improvements are becoming an increasingly important part of the fast-growing Soviet program for economic assistance to underdeveloped countries and coincide with Soviet plans to provide regular air service to these areas.**

▶ American Airlines will convert five additional Douglas DC-7 passenger aircraft to an all-cargo configuration to bring to 15 the total of DC-7F cargo planes the carrier will have in its all-cargo fleet by the end of 1960.

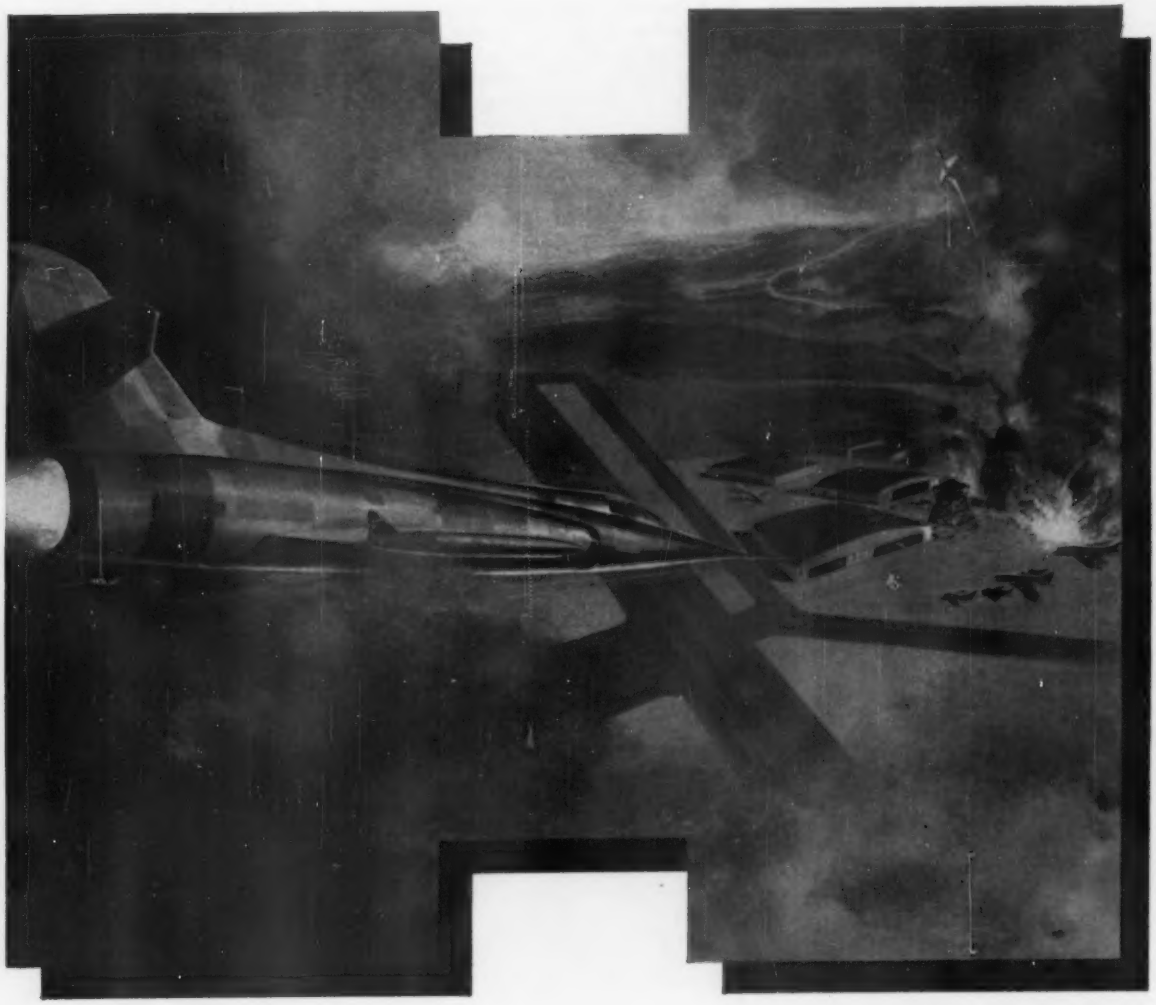
▶ **Federal Aviation Agency will introduce a management experimental plan designed to transfer operating responsibilities and decision-making authority from regional offices to lower echelon field offices in the Bureaus of Air Traffic Management and Facilities and Materiel. The plan will be conducted on a 90-day trial basis and will remove supervision of day-to-day operations from regional offices and give area offices direct-line responsibility over traffic facilities and activities.**

▶ Civil Aeronautics Board has established interim rates for the air transportation of first-class mail pending a decision on final rates for the handling of all classes of mail on a non-priority basis. First-class rates were set at 50% of those already in effect for air mail.

▶ **Latest report on the expansion of credit facilities of the Universal Air Travel plan since the program was begun six months ago (AW Oct. 12, p. 48) show that the cards may be used for credit at 368 hotels, 398 motels, 32 car rental organizations and 85 restaurants.**

▶ Air Transport Assn. has retained Stanford Research Institute to undertake an investigation of possible means of sabotage of aircraft in an effort to gain more specific knowledge of explosive devices and ways and means of detecting them.

How to radically increase tactical



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5. Human-engineered displays and controls for greater safety and ease of operation.
6. Attack modes which can accurately deliver any desired armament.
7. A system which is low in weight and small in volume... and easily maintained in the field.
8. A low initial cost and a low maintenance cost!

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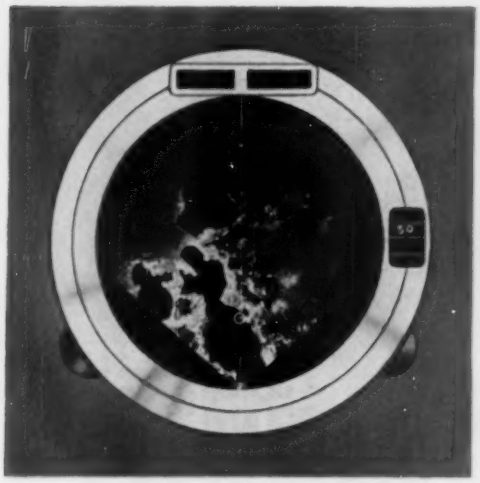

The display above furnishes radar information as a navigational check against the moving map display (right). In this way, it is possible to navigate directly to target in all kinds of weather!

The Moving Map Display provides the pilot with continuous position and course information. At each designated check point during the mission, the system automatically checks the map position against the radar display and makes the necessary flight corrections.

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Airline Income & Expenses—January, 1960

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	30,038,639	655,480	371,246	1,756,940	.....	33,317,008	31,902,797	1,414,211
Braniff	5,198,396	124,563	60,016	153,639	26,834	5,644,696	5,582,792	−31,895
Capital	7,458,408	177,773	103,753	115,084	11,189	7,990,146	9,634,238	−1,644,090[3]
Continental	4,895,000	70,000	51,000	82,000	.....	5,208,000	4,514,000	457,000
Delta	9,308,000	163,000	100,000	303,000	.....	10,102,000	9,704,000	263,000
Eastern	22,665,230	413,738	975,646[2]	.....	76,609	24,237,626	23,434,125	524,572
National	5,813,994	108,141	30,170	153,682	93,197	6,589,269	6,617,273	557,842
Northeast	2,909,151	48,504	16,538	53,671	.....	3,104,739	3,540,948	−436,209[3]
Northwest	6,754,294	194,481	587,753[2]	.....	43,179	7,633,126	7,395,878	102,136
Trans World	20,527,866	590,141	1,210,720[2]	.....	80,826	22,488,530	22,675,721	−123,030
United	20,447,213	726,863	1,721,572[2]	.....	56,382	23,350,379	25,932,087	−1,878,581
Western	5,413,866	114,203	39,000	98,016	22,457	5,754,891	4,397,702	1,118,538
INTERNATIONAL								
American	558,444	8,599	85	32,697	.....	630,605	609,247	23,356
Braniff	517,050	12,866	.....	27,181	.....	596,997	809,764	−225,245
Caribbean Atlantic	272,149	2,260	12,678[2]	.....	699	295,597	262,010	34,085
Delta	326,000	4,000	.....	15,000	.....	361,000	383,000	−28,000
Eastern	2,062,071	40,336	80,110	.....	9,657	2,197,251	2,032,853	39,111
Mackey	139,687	.....	730	2,848	.....	157,737	149,067	8,670[3]
National	195,574	1,635	234	2,960	23,091	231,179	234,783	−3,604
Northwest	1,586,920	567,212	346,281[2]	.....	−231	2,587,573	2,978,619	−450,124
Pan American Combined	22,543,000	1,519,000	.....	2,731,000	405,000	28,420,000	29,065,000	−1,100,000
Alaska	242,000	14,000	.....	25,000	2,000	292,000	494,000	−202,000
Atlantic	8,946,000	646,000	.....	1,077,000	270,000	11,471,000	11,341,000	157,000
Latin America	7,259,000	206,000	.....	1,053,000	83,000	8,987,000	9,788,000	−822,000
Pacific	6,096,000	653,000	.....	576,000	50,000	7,670,000	7,446,000	224,000
Panagra	1,117,000	46,000	.....	185,000	.....	1,484,000	1,620,000	−126,000
Resort	.....	.....	.....	.....	403,271[4]	404,481	394,181	10,300[3]
Trans Caribbean	403,487	.....	60,589[2]	.....	.....	517,312	528,789	−22,367
Trans World	3,219,715	524,343	404,852[2]	.....	129,142	4,545,160	5,897,239	−1,366,405
United	782,755	42,704	22,643[2]	.....	.....	867,757	884,211	−35,473
Western	458,538	4,574	.....	4,093	.....	475,054	367,909	103,662
LOCAL SERVICE								
Allegheny[1]	.....	.....	.....	.....	.....	.....	.....	.....
Bonanza	339,902	2,129	2,426	4,769	7,234	520,821	584,979	−46,159
Central	174,608	6,393	1,382	5,379	315	426,769	480,307	−53,538[3]
Frontier	456,685	12,451	4,366	25,157	7,404	1,034,851	1,103,478	−87,248
Lake Central	190,795	4,718	7,871	.....	481	357,341	316,119	−38,778[3]
Mohawk	634,512	9,346	7,412	13,620	3,692	840,265	997,123	−156,858[3]
North Central	894,177	26,793	18,000	15,207	20,851[4]	1,455,242	1,618,109	−180,625
Ozark	465,768	14,987	9,961	15,760	1,164	791,311	1,049,134	−257,823[3]
Pacific[1]	.....	.....	.....	.....	.....	.....	.....	.....
Piedmont[1]	.....	.....	.....	.....	.....	.....	.....	.....
Southern	279,424	10,236	4,435	7,223	3,012	534,837	592,146	−57,309[3]
Trans-Texas[5]	355,172	14,904	7,705	15,529	12,673	657,134	699,004	−43,475
West Coast	448,150	10,946	2,203	6,177	5,763	794,441	949,346	−154,905[3]
HAWAIIAN LINES								
Aloha	325,905	1,830	.....	5,510	31,722[4]	376,007	375,835	173[3]
Hawaiian	506,656	2,659	.....	62,026	149,276[4]	740,675	705,435	15,004
CARGO LINES								
AAXICO	.....	.....	.....	.....	856,927	917,809	818,492	99,317
Aerovias Sud Americana	.....	.....	.....	112,768	123,122	235,954	221,436	14,518[3]
Flying Tiger	.....	21,980	1,194,712[2]	.....	997,685	2,186,875	2,460,706	−369,270
Riddle	.....	.....	.....	417,975	.....	425,104	538,495	−113,390[3]
Seaboard & Western[1]	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	.....	.....	.....	1,100,734	1,159,095	1,096,789	62,306[3]
HELICOPTER LINES								
Chicago Helicopter	114,463	113,834	.....	.....	.....	228,381	235,567	−9,191
Los Angeles Airways	17,379	11,306	9,349[6]	.....	175	117,407	108,577	8,839
New York Airways	67,822	4,393	4,303	2,761	.....	265,979	266,268	−1,567
ALASKA LINES								
Alaska Airlines	160,101	46,658	921	41,315	220,268	669,123	684,438	−26,030
Alaska Coastal	49,700	9,300	.....	6,417	1,005	137,831	139,003	−38,806[3]
Cordova	8,951	7,463	.....	5,409	21,625	97,213	102,609	−7,065
Ellis[1]	.....	.....	.....	.....	.....	.....	.....	.....
Northern Consolidated	36,435	37,611	.....	16,212	7,826[4]	214,761	241,437	−26,676[3]
Pacific Northern	372,768	57,623	1,633	59,125	10,175	748,276	884,120	−147,859
Reeve Aleutian	95,489	35,082	.....	35,234[8]	30,399	197,812	174,107	23,477
Wien Alaska	48,330	33,772	.....	21,186	16,248	295,012	329,386	−34,374[3]

[1] Not available. [2] Property figure. [3] Net operating income. [4] Non-scheduled transportation. [5] Airline division figures.
[6] Express & excess baggage. [7] Common carriage. [8] Freight and excess baggage.
Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.

Solar *Titan* turbine being flight tested in Gyrodyne Rotorcycle helicopter.

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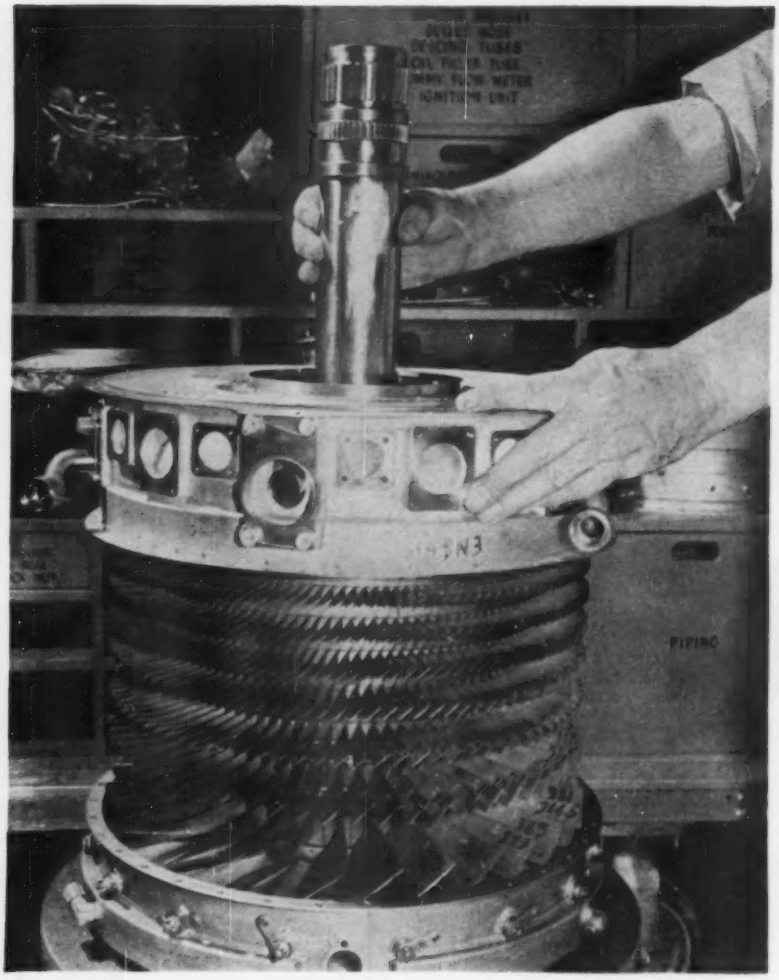
SOLAR
AIRCRAFT COMPANY

J85-7 powers GAM-72 aboard F-102A. Test flights have included afterburner operation to 50,000 ft. and speeds to Mach 1.23.

Versatile J85 Built for Maintainability

By Robert I. Stanfield



EIGHT-STAGE compressor rotor of J85. Rotor rpm., all engines, is 16,500 (100%).

Lynn, Mass.—Design details of General Electric's J85 turbojet reveal a small, lightweight Mach 2 engine with a high thrust-weight ratio. Built with an eye toward simplicity and maintenance, the J85 is easily assembled and requires little heavy equipment for assembling and disassembling.

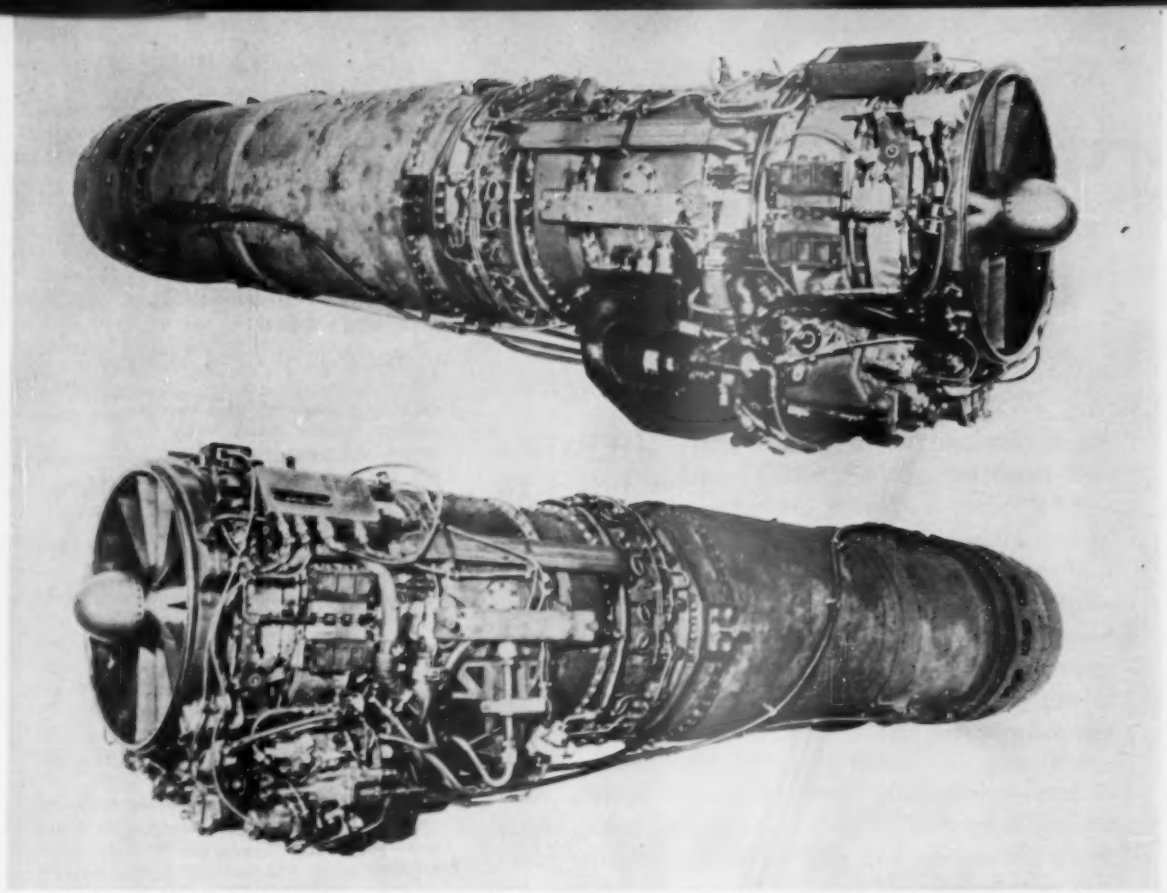
It is a versatile engine. The J85 powers McDonnell's GAM-72 Quail decoy missile. Northrop's Radioplane Division will use it to power the Q-4B supersonic target drone. It was used to power North American's T-39 Sabreliner executive transport. It is also used with Northrop's Mach 1.2 T-38 Talon trainer and the Mach 1.45 N-156F Freedom Fighter. Advanced J85 thrust-augmentation system is expected to push the N-156F in excess of Mach 2.

Compact Engine

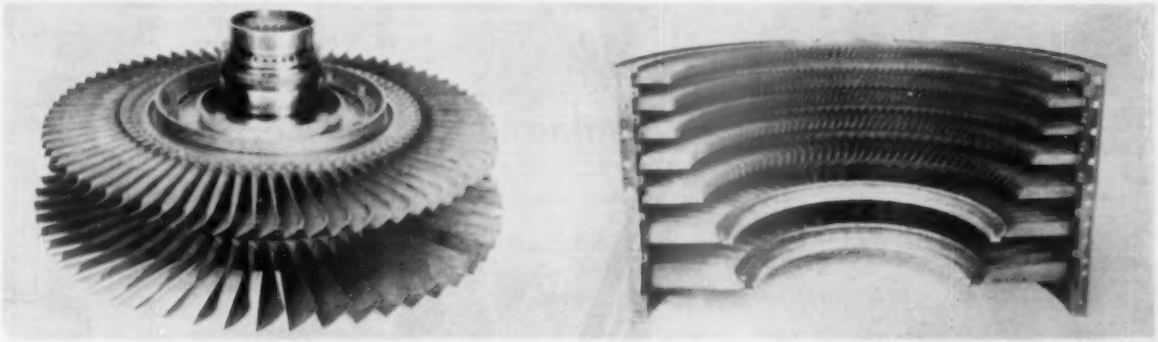
The J85 is a compact engine with an axial-flow compressor coupled directly to a two-stage turbine. It incorporates a through-flow annular type combustion system, controlled compressor interstage bleed and—in the piloted afterburner version—a burner with variable area exit nozzle.

Variable inlet guide vanes and variable interstage air bleed valves regulate compressor airflow and assist in rapid speed transition. Complete engine-mounted lubrication system and an air impingement starter are furnished as integral parts.

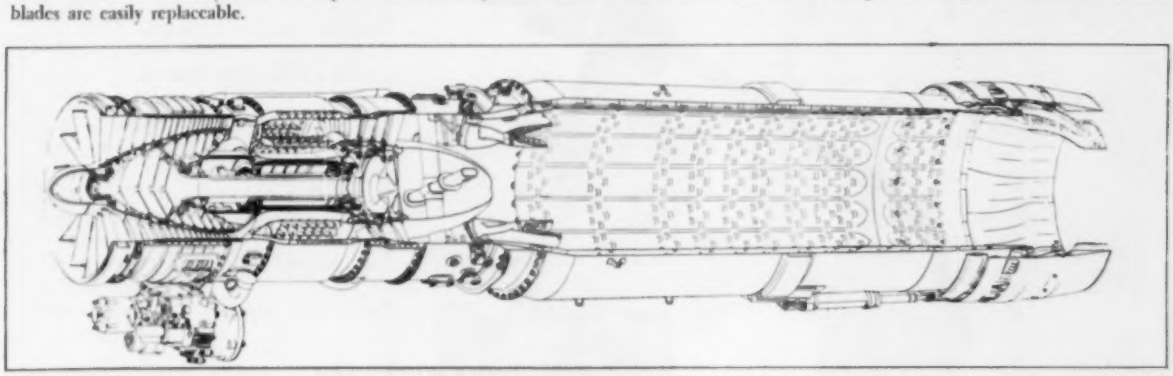
Advanced design for the J85—initially a short-life missile engine—was formulated in 1953. Evolution of the long-life, seven-stage dry-piloted and after-



J85-5 PILOTED ENGINE, with afterburner. Top is right-side elevation; bottom, left side of engine. Weight is 525 lb. Over-all length is 104.2 in. Maximum thrust is 3,850 lb.



TURBINE wheel assembly (left) and top half of J85 compressor stator. Turbine blades are solid; cooling is via compressor bleed air. Stator blades are easily replaceable.



CUTAWAY of the J85-5. Diameter at maximum flange is 20.2 in. (across gearbox). Turbine shaft attaches to the fourth-stage wheel; front shaft is bolted to the first-stage wheel.

THEY RELY ON RADIATION

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On a 7-mile long track, these sleds test warheads, missiles, airfoils, missile components, and human tolerances, transmitting their data to a telemetry building which is the intelligence center for track operations. There, a digital telemetering system receives, translates and processes the data. The entire telemetry system—from output of the sled-borne transducers to computer input—was designed and built by Radiation Incorporated.

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burner engines began in 1956. These included the J85-3 missile engine for GAM-72, J85-1 piloted engine for the T-38 and N-156, and the J85-X (−1 engine with long shell removed; with longer gearbox than missile engine) for the T-39.

In 1957 compressor performance problems resulted in addition of an eighth stage to the seven-stage compressor, plus addition of No. 1 bearing, making three in all. Additions were made without increasing length of the engine and, in the case of the missile

J85 Development History

1953/1954:

Advance design formulated.
USAF development contract awarded in Dec. 1954.

1955:

Jan.—Project formed.
Feb.—Design/components development begun.
Nov.—First component tests.

1956:

Jan.—First engine test.
June—First contract (GAM-72).
Development of dry-piloted and afterburner engines undertaken.

1957:

July—8-stage compressor announced. First 7-stage engines delivered.

1958:

Jan.—2,000 hr. J85 factory, field and flight hours reached. J85-7 (8-stage) completes official 15-hr. qualification tests.
March—J85-3 (7-stage) completes 15-hr. QT.
May—GAM-72 captive flight tests begin.
August—YJ85-1 (7-stage, afterburner) completes 50-hr. preliminary flight rating tests (for T-38). First GAM-72 free flight (−3 engine). Eight-stage J85 demonstrates guaranteed military thrust and speed.
Sept.—T-39 Sabreliner first flight with X engine (−1).

1959:

Jan.—J85-7 (8-stage) completes official 15-hr. QT.
March—F-102 flight test bed operation begins.
April—T-38 first flight (−1 engine).
June—Q4-5 contract announced (J85-5 engine).
July—N-156F first flight (−1 engines).
Sept.—YJ85-5 (8-stage) completes official 50-hr. PFRT.
Oct.—First YJ85-5 engines shipped (to T-38 program).
Dec.—First T-38 flight with afterburner engines.

1960:

March—10,000-hr. test mark passed. First GAM-72 J85-7 free flight.

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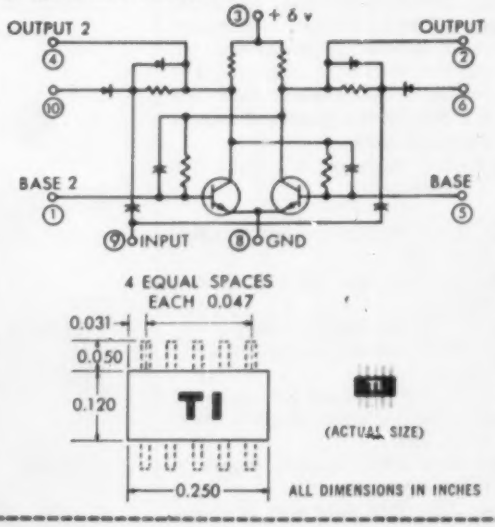

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SEMICONDUCTOR-COMPONENTS DIVISION

POST OFFICE BOX 312 • DALLAS, TEXAS

engine, without additional weight (this by shortening the frame slightly and putting an extra stage of stators in main frame section).

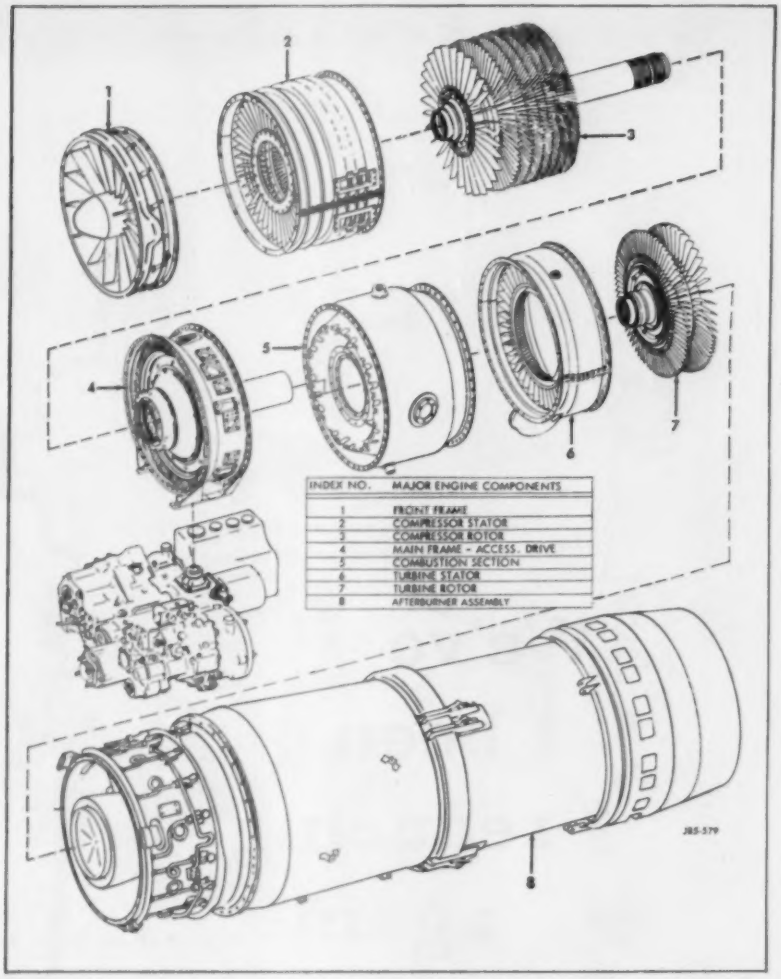
Eight-Stage Engines

Growth potential of 20-25% is foreseen for the J85, Gerhard Neumann, general manager of General Electric's Small Aircraft Engine Department (SAED) told AVIATION WEEK. Current eight-stage J85 variants are as follows:

• **J85-7 missile engine.** Completed official 15-hr. qualification test in January, 1959. Engine weight is 325 lb. Specific weight is .132. Over-all length is 42 in.; diameter at maximum flange is 17.7 in. Military thrust is 2,450 lb. and specific fuel consumption .975 lb./hr./lb. (sea level static). First free flight in the GAM-72 was in March, 1960. The engine currently is at Wright Air Development Center, Dayton, Ohio, for official altitude qualification tests.

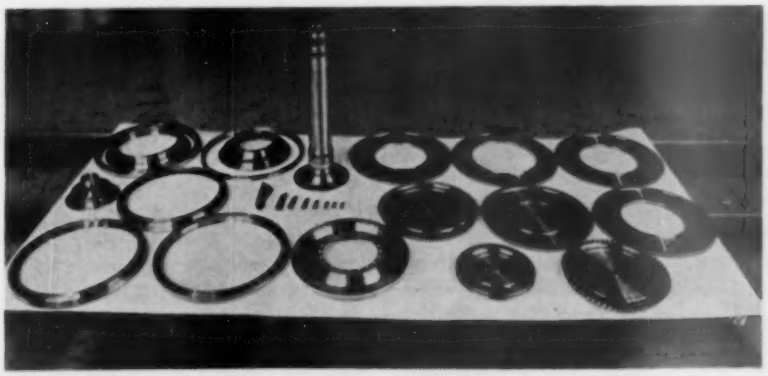
• **YJ85-5 piloted afterburning engine.** Completed official 50-hr. preliminary flight rating tests in September, 1959. Maximum burner thrust is 3,600 lb. and specific fuel consumption 2.25 lb./hr./lb.; military thrust is 2,450 lb. and specific fuel consumption 1.05 lb./hr./lb. (sea level static). First engines were shipped to the T-38 program in October, 1959. The engine currently is undergoing altitude tank testing at Arnold Engineering Development Center, Tullahoma, Tenn. Modified YJ85-5s will be used for flight testing of a Q-4B target drone in mid-1960.

• **J85-5 piloted afterburning engine.** Demonstrated guaranteed military thrust and speed in August, 1958. Engine weight is 525 lb. Specific weight is .136. Over-all length is 104.2 in.; diameter at maximum flange is 20.2 in. (across gearbox, otherwise 16 in. at inlet). At maximum burner, thrust is 3,850 lb. and specific fuel consumption 2.20 lb./hr./lb.; military thrust is 2,500 lb. and specific fuel consumption 1.01 lb./hr./lb. (sea level static). Qualification test is scheduled for July, 1960 (150-hr.). Engine will replace YJ85 currently in use. Guaranteed performance has been achieved in factory tests.



MAJOR J85 engine components. Engine incorporates mostly steel and alloys. Horizontally split stator casing aids inspection and maintenance. First-stage blades are pinned.

Total J85 operating hours, as of mid-March, approximated 10,114. Total engines shipped from the Lynn facilities of SAED, between July, 1957, and Mar. 10, 1959, were 145. Of this number, 35 were eight-stage engines (the first of which was delivered in March, 1959); 110 were seven-stage (the first delivered in July, 1957; the last to be delivered this month).



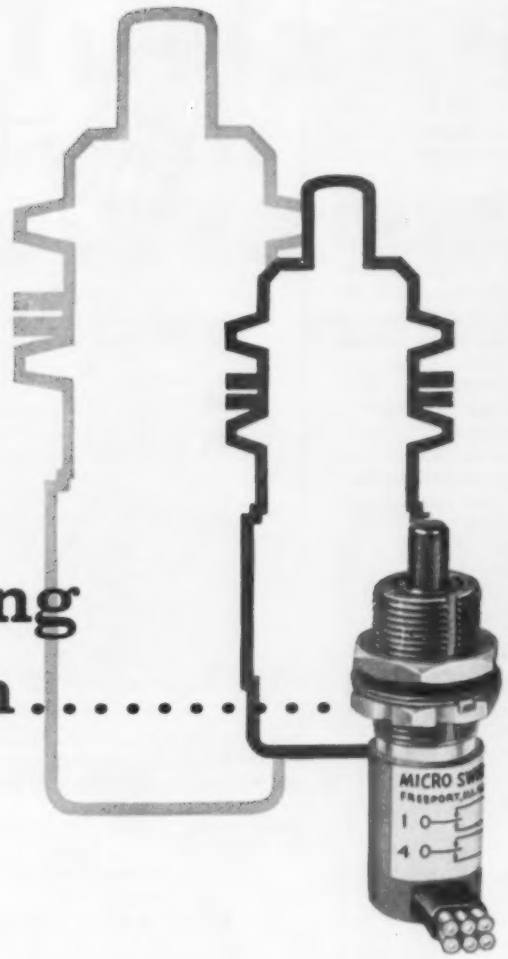
COMPRESSOR rotor of J85-5, broken down following 50-hr. preliminary flight rating test.

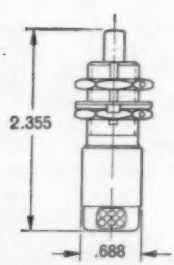
Current Production

In 1959 SAED shipped 71 engines; in 1960 it will ship 275 (majority for the GAM program). Current production rate is 16 engines per month, building up to 40 a month. SAED has the facilities and tooling to produce 100 engines per month. General Electric expects at least a 50% production increase next year, to about two-thirds capacity. Deliveries on signed contracts will run through November, 1961; proposals are now out beyond that point. All J85 models are qualified except the −5, scheduled for this July.

Confidence in the J85 also led to SAED's development of the commercial CF700-1, which combines the J85 gas generator with an aft fan, based on CJ-805 experience. Takeoff thrust of the CF700, sea level static, is specified

We've been reducing again.....





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For more information on this new unit, check the Yellow Pages for the nearest MICRO SWITCH branch office or write for Data Sheet No. 171.

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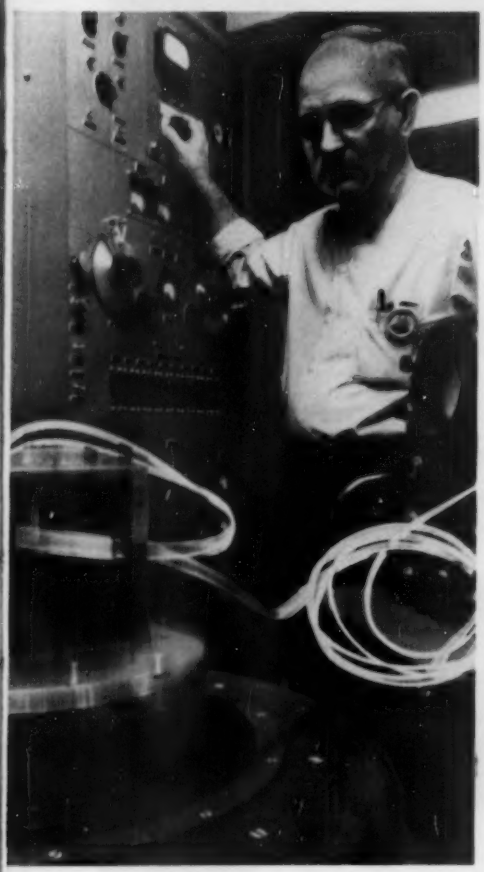

Before choosing a sealed switch . . . ask this vital question:

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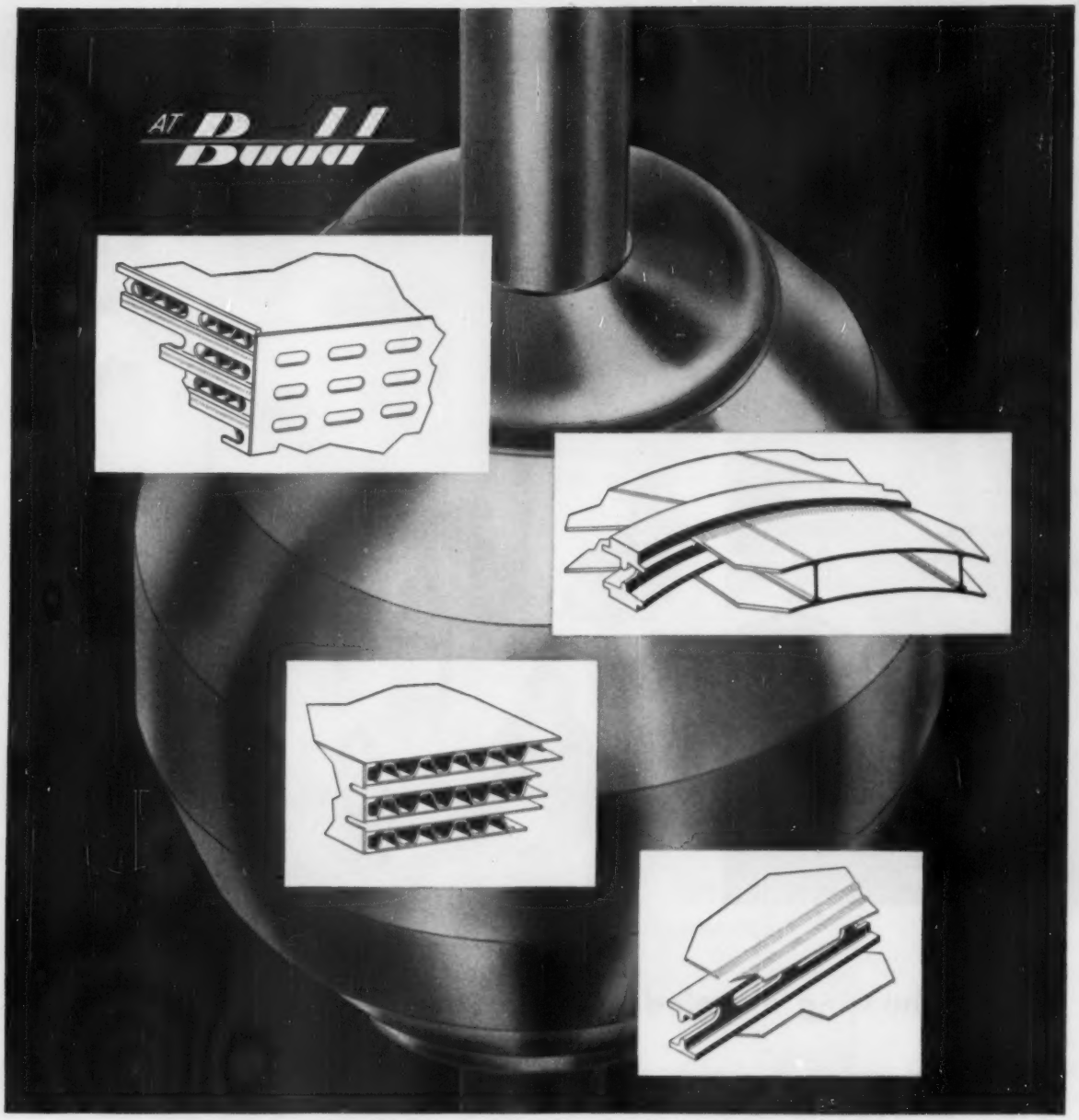

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SPACEATOMICS Budd DIVISION

as 4,000 lb.; specific fuel consumption .69 lb./hr./lb. (at 36,000 ft., Mach .8, sfc. is .97 lb./hr./lb.). Engine weight is 585 lb. Bypass ratio is 2:1.

Engine will go to test in May. Federal Aviation Agency certification is expected by early 1962 (AW Oct. 19, 1959, p. 128). Basic fixed price will be $61,000, not including the thrust reverser, optional at $9,000.

General Electric aims at increasing both temperatures and airflow in its current small engines: T58, T64, J85 and the CF700. SAED also is studying the small commercial market in relation to a light, inexpensive engine, either turboprop or pure jet, which would be adaptable to single-engine or small-twin aircraft, in addition to VTOLs. The J85 was designed basically to operate vertically. With external plumbing eliminated for VTOL operation, and with no development effort, SAED feels it can get 9:1 to 10:1 thrust/weight ratio.

J85 Components

The J85 compressor, eight-stage, is of axial-flow transonic design. Rotor rpm. (all engines) is 16,500 (100%). Mass-flow is 42.5 lb./sec.; pressure ratio is about 7:1. Stall pressure ratio is 8:1. Variable inlet guide vanes are anti-iced on the piloted version. A horizontally split stator casing aids inspection and maintenance. The first two stator stages are shrouded. Third, fourth and fifth stages bleed for acceleration purposes, serving the same functions as would variable stators.

Through-flow annular design combustor incorporates a louvered liner for over-temperature protection. Liner perforations allow for thorough mixing, and uniform temperature distribution. Twelve dual-orifice "duplex" fuel nozzles set an optimum spray pattern. Two liner inspection ports allow for ease of inspection and maintenance. External insulation blanket reduces engine bay temperature.

Two-stage, axial-flow turbine is cooled by compressor bleed air. Casing is split horizontally for inspection-maintenance. General Electric engineers stressed ruggedness of the J85, pointing out that they have never had failure of wheel or failure of any disk in compressor, or failure of any turbine bucket or any compressor blade, during more than 10,000 hr. of operation. Turbine blades are solid (no air flow through blades); shank-type blade design moves the turbine wheel away from the hot gas stream.

Afterburner (J85-5) incorporates variable area primary nozzle, of which the engine control system holds a constant turbine temperature. Cooling air passes through a louvered inner liner. Pilot burner-flame holder is combined in engine. Thrust can be modulated from minimum to maximum afterburning. Primary fuel system (four spray bars) is for minimum afterburner and annular pilot supply; secondary fuel system (12 spray bars) is for minimum to maximum burner. The nozzle position is automatically regulated.

J85-5 Performance Ratings

(standard sea level static)

Rating	Min. Thrust	Max. RPM	Max. SFC (lb./hr./lb.)	Measured Rated Gas Temp.
Maximum Afterburner	3,850 lb.	16,500	2.20	1,220 F
Military	2,500 lb.	16,500	1.01	1,220 F
Normal (90%)	2,050 lb.	15,675	.98	———
Normal (75%)	1,845 lb.	15,345	.98	———

Performance Ratings (standard altitude):

Rating	Altitude	Mach	Min. Thrust	Max. RPM	Max. SFC lb./hr./lb.	Measured Rated Gas Temp.
Maximum Afterburner	36,089 ft.	1.8	3,265 lb.	16,500	2.16	1,220 F
Military	36,089 ft.	1.4	1,080 lb.	16,500	1.52	1,220 F
Military	36,089 ft.	0.8	790 lb.	16,500	1.33	1,220 F

YJ85-5 Preliminary Flight Rating Tests

Performance vs. Specifications*

Ratings	Max. Afterburner	Military	Normal	Normal (90%)	Normal (75%)
Thrust:					
Actual	3,622 lb.	2,557 lb.	2,255 lb.	2,065 lb.	1,760 lb.
Specifications	3,600 lb.	2,450 lb.	1,980 lb.	1,780 lb.	1,485 lb.
RPM:					
Actual	16,500	16,500	15,675	15,345	14,850
Specifications	16,500	16,500	15,675	15,345	14,850
SFC (lb./hr./lb.):					
Actual	2.17	1.02	1.01	1.01	1.04
Specifications	2.25	1.05	1.02	1.03	1.05
Gas Temp. F:					
Actual	1,175 F	1,175 F			
Specifications	1,175 F	1,175 F			

J85-7 Official Qualification Test

Performance vs. Specifications*

Ratings	Military	Normal	Normal (90%)	Normal (75%)
Thrust:				
Actual	2,645 lb.	2,118 lb.	1,894 lb.	1,605 lb.
Specifications	2,450 lb.	2,000 lb.	1,800 lb.	1,500 lb.
RPM (%):				
Actual	100	95.76	94.06	90.91
Specifications	100	95.76	94.06	90.91
SFC (lb./hr./lb.):				
Actual	.965	.967	.972	.990
Specifications	.975	.990	1.000	1.020
Gas Temp.:				
Actual	1,140 F	1,000 F		
Specifications	1,160 F	1,025 F		

* (Corrected to NASA sea level standard conditions, 100% ram recovery, no bleed)

Rotor Construction

The J85 rotor is not shaft-type construction. Each wheel is connected to the adjoining wheel and the drive of the rotor is from one wheel to another. Turbine shaft attaches to the fourth-stage wheel, and the front shaft is bolted to the first-stage wheel. First-stage blades are pinned; the rest are dove-tailed, but not too rigidly, so as to avoid vibration and allow for expansion in heat. By pulling off the front end, the first-stage rotor blades can be changed without taking the rotor apart. Stator blades can be replaced by removing half the case at a time. The entire gear box and control system can be removed as a unit.

Electrical systems include ignition,

gas temperature thermocouples, anti-icing, tach generator and alternator unit, junction box and exhaust temperature amplifier (afterburner version).

The gearbox is driven by a radial drive shaft coming through the main frame of the engine. In the case of the piloted engine, with gearbox on the bottom, the main frame is turned so that the shaft protrudes at the bottom (with the missile engine, it is rotated around and brought out on top).

The engine is lubricated via a positive displacement, pressurized, recirculating system. Maximum oil consumption is 0.60 lb./hr. at military and normal power. Scavenge to output ratio (combination lube-scavenge pump) is 3.2:1. All components are engine-furnished and engine-driven.

Starting System

All engines embrace air impingement starting (though they can be wound up through the gear box, should starter be installed). Minimum air flow is 100 lb./min. Minimum pressure is 43 psig.; overhung moment is 100 lb.-in. Starting temperatures run from plus 130F to minus 65F. J85 fuel grade is JP-4

Light weight of the J85 was achieved through construction design, incorporating mostly steel and alloys. No titanium is used. Breakdown is as follows:

• **Compressor:** disks, AM-355; blades, Greek Ascaloy, AM-355; vanes, 403; casing, Cr-MO-V (chrome molybdenum alloy); shaft, A286. Front frame, 403; main frame, Cr-MO-V. Turbine: rotating seal, A286; wheels, A286; buckets, M252, S.E.L.; casing, Inconel X; diaphragm, L605. Combustor: liner, Incoloy T, Hastalloy X; casings (inner-outer) Cr-MO-V.

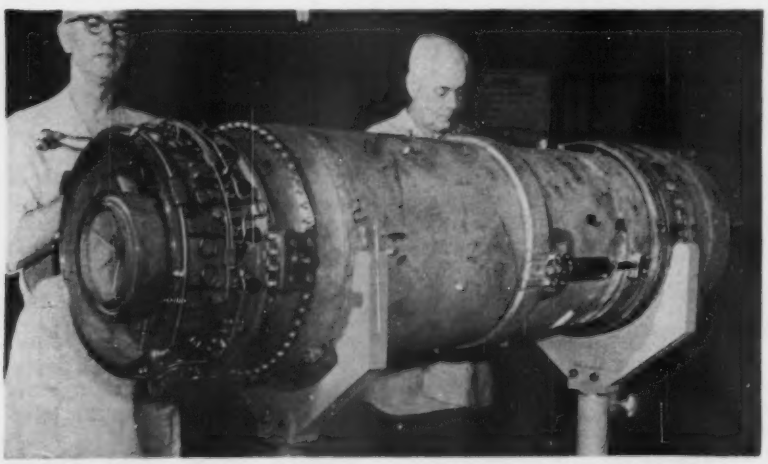
• **Accessories:** gear box support, AISI 8740; carbon seals, 150 "Graphitar"; gear casing, AZ92; gears, 9310; bearings, MHT-521000; seal runners, 8740. Afterburner: casing, A286; liner, "Inco" 702; nozzle, "Inco" 702; nozzle tracks, R-41; and flameholder, W155. At the Arnold Engineering Development Center both the −5 and −7 engines, in altitude tank and wind tunnel tests, successfully operated at Mach 2, 60,000 ft., and demonstrated altitude afterburner operation. They were evaluated at all conditions of flight and altitude within the flight envelope. At the Wright Air Development Center the −3 and −7 engines, in altitude tank and during climactic tests, demonstrated performance at altitudes ranging to 60,000 ft., demonstrated high-speed stall and low-speed blow-out limits, engine altitude endurance and resolved variable geometry schedule. Low-temperature starting was demonstrated to −65F.

The J85-1, −5 and −7 engines, in the GAM-72, are also testing in the General Electric bailed Convair F-102A test bed at Edwards AFB. Flights to date total about 97 (at mid-March); flight hours totaled 45. Accomplishments include afterburner operation to 50,000 ft., flight speeds to Mach 1.23, afterburner light-off at 45,000 ft., engine light-off at 28,000 ft. Tests will also be run in General Electric bailed T-38. Other applications have included:

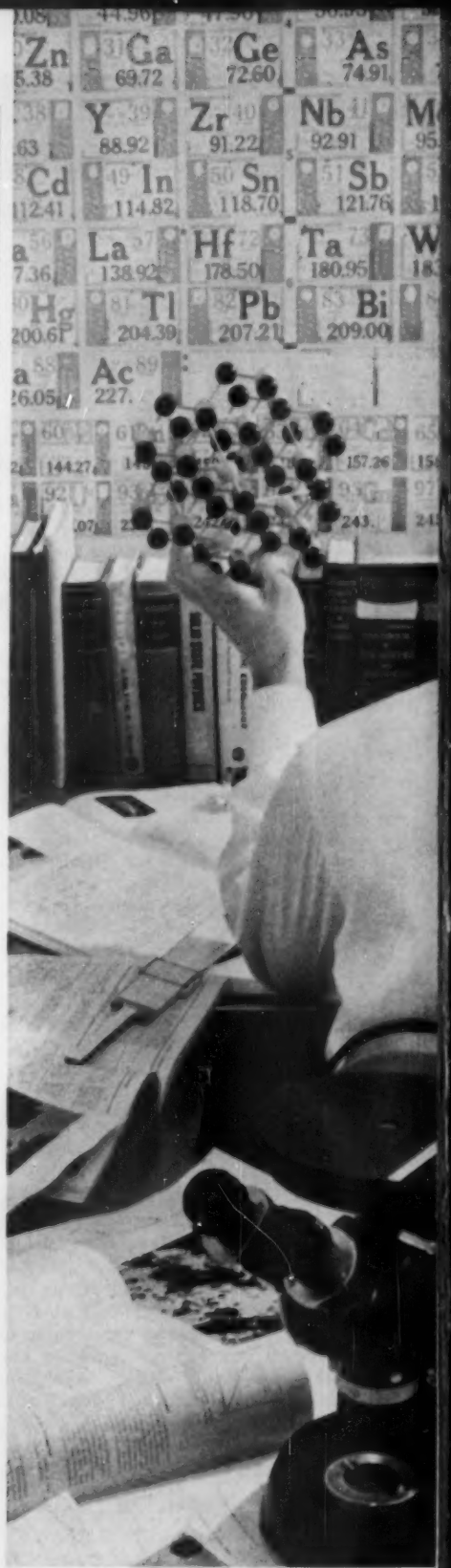
• **T-38 Talon.** Flights through Mar. 10 with −1 engines totaled 161; with −5 engines, 14. Engine flight hours (twin-engine installation) totaled 319. Three aircraft are currently flying, two with −1 engines, the other with −5s. Supersonic flights have been conducted to 40,000 ft. at Mach 1.2. Engines are on contract through November, 1961.

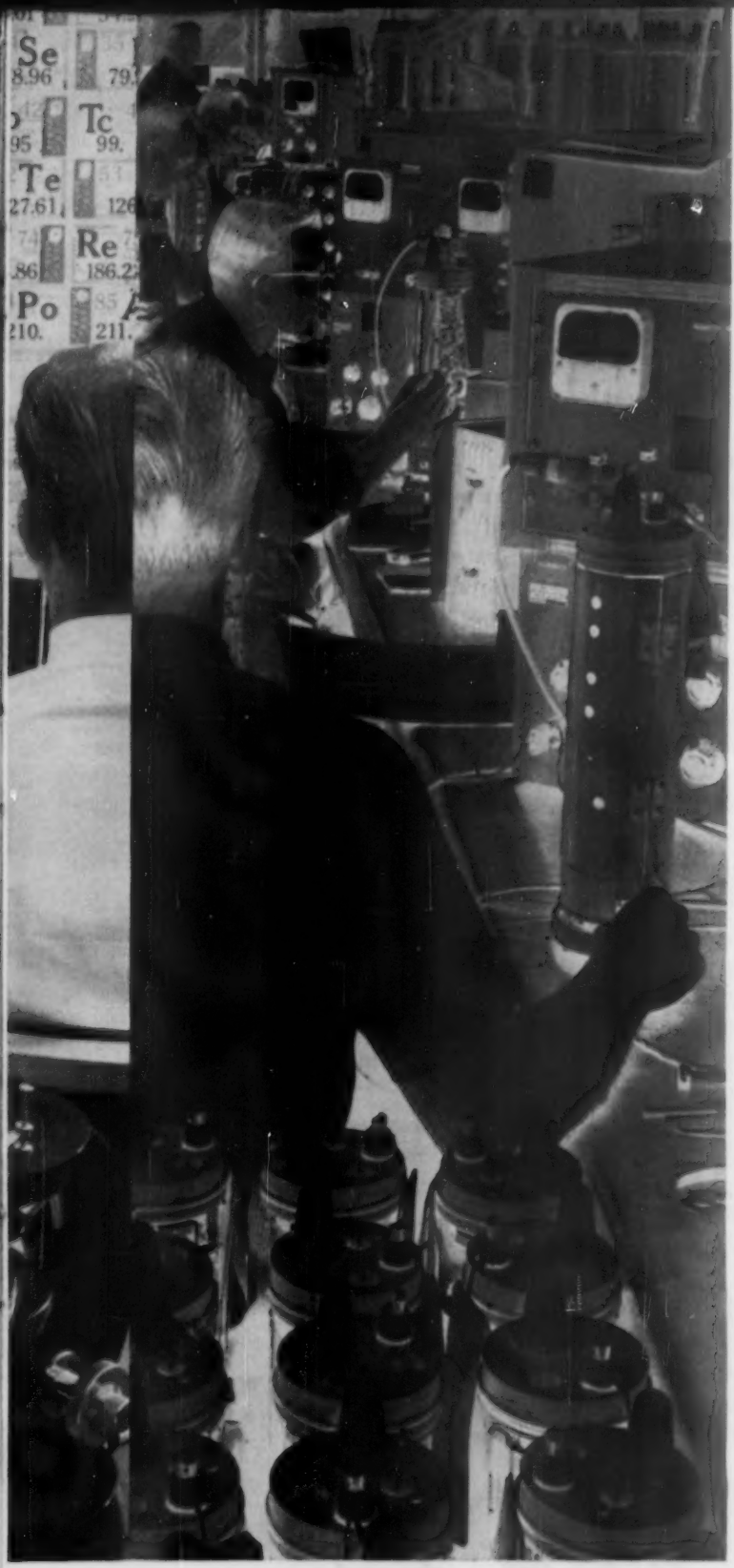
• **N-156F Freedom Fighter.** At mid-March, total flights with YJ85-1s totaled 26; with YJ85-5s totaled 17. Flight hours totaled 71. One aircraft is currently flying. Speed is Mach 1.45; supersonic speed was reached during first flight. Production program is not funded.

• **T-39 Sabreliner.** One aircraft has been flown with YJ85-X engines for a



AFTERBURNER of J85-5. Features include louvered liner and thrust modulation.





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Producing and handling liquefied gases at ultra-low temperatures has been the specialized business of Air Products for over 20 years. We will welcome the opportunity to answer your questions about obtaining and handling liquid hydrogen, and to put our experience to work for you. Air Products, Inc., Allentown, Pa. Phone: EXpress 5-3311.

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total of 70 flights and 155 engine flight hours. The T-39 was operated to 30,000 ft., with flight speeds to Mach .73. Program is complete; aircraft gross weight increase required higher thrust engine.

Target Tests

The GAM-72 flight test program, with – 3 and – 7 engines, has run over 78 total engine flight hours. Substantial numbers of – 7 engines are on order. Flight testing of the Radioplane Q4-B will begin in mid-July. Two YJ85-5s have been delivered to date; project is funded through development only. General Electric will ship 16 engines for 10 Q-4Bs. The – 5 engine (dry) also will be used with the experimental Bell X-14 STOL research vehicle with NASA; vehicle initially utilized – 3s.

The J85 has been proposed for use with smaller helicopters, to unload the rotor (lift out of ground effect and augment helicopter system, allowing bigger loads), and for propulsion for the high-altitude Dyna-Soar phase (providing thrust when vehicle re-enters atmosphere, to get it back to the ground).

The Lynn plant of SAED includes four production test cells and seven development test cells for J85s. The – 7 engines have been running 6-7% better than specifications in the test cells, AVIATION WEEK was told. Recent YJs have been running 1.5 to 2% over specifications, thrust, in afterburner (military above 5% better).

The YJ85-1 engines are authorized for 75 hr. service between overhaul; this is expected to increase to 100 hr. this month. Nature of the test programs has not allowed determination of the J85 overhaul potential.

Field maintenance characteristics of the J85 are good. Four men working a normal shift have removed both engines from the T-38 or N-156F, made a periodic inspection, reinstalled, rigged, leak-checked and preflighted these engines, readying the aircraft for flight. Engines have been completely disassembled in field service shops and compressor section rebuilt to correct foreign object damage. J85s were returned to service within seven days.

Design Features

Additional design features stressed by General Electric include:

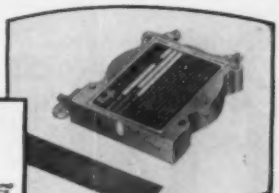
- **All major engine** assemblies may be assembled or disassembled either vertically or horizontally except for the compressor section, which must be assembled vertically.
- **First stage compressor** rotor blades (moment weighted) can be replaced without machining, rotor disassembly or rebalancing. No machining is required in replacing of the blades of the other stages.
- **Variable inlet guide vanes** can be re-

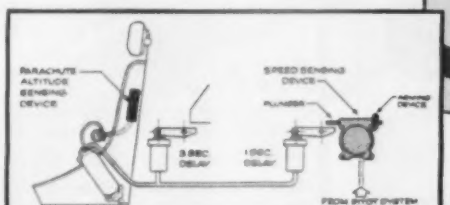
new EMERGENCY ESCAPE DEVICES
solve Automatic Sequencing Problem!

When a pilot ejects at high speeds, seat-man separation is delayed two seconds to prevent injury and parachute tearing. *However, this delay at low altitudes, where ejection is rarely made at extreme speed, may prevent full parachute opening before the pilot hits the ground!*

To reduce this delay and to increase pilot safety at low altitudes, Pacific Scientific has developed a *Speed Sensor* and a *Parachute Release Actuator* for the Air Force that cuts the two second delay to one second – and deploys the parachute in less than 1/10th second! In addition, these two devices permit a three second delay at high speeds – and high altitudes – thus providing the correct sequence of automatic seat separation and parachute deployment under any condition!

Both devices are unusually simple, rugged and dependable. And they are designed to permit easy installation on existing equipment at little cost! This is *the type of reliable engineering ingenuity Pacific can offer your company . . . the capability to resolve perplexing problems with practical, simple solutions.*





Pacific's miniature Speed Sensor (above) and Parachute Altitude Sensing Device (indicated in diagram) are the key elements in this new Emergency Escape System.

If your problem is in controls, instruments, or safety equipment, discuss it with Pacific. Do so today!

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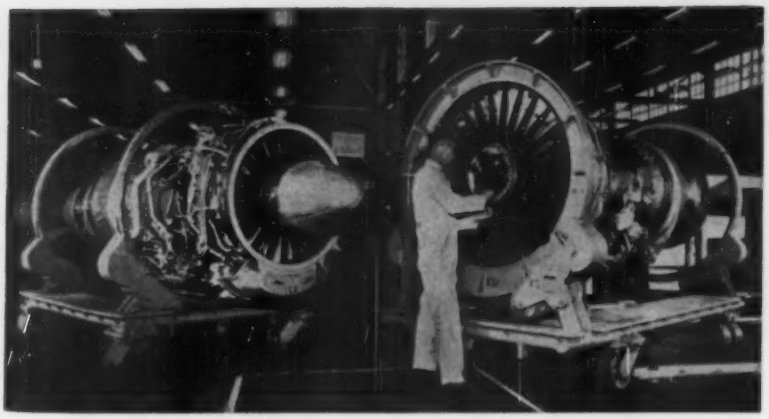

Pratt & Whitney Turbofan, J57 Compared

Pratt & Whitney TF-33 turbofan engine (right) which will power the Boeing B-52H eight-jet bomber (AW Mar. 7, p. 75) is compared with the Pratt & Whitney J57-P43W turbojet for the B-52G, at left. Commercial turbofan version, the TF-33-3 will power the Boeing 707-120B and 720B jet transports.

placed without destructive disassembly or machining. Stator vanes are clustered in replaceable segments. Combustion liner is replaced by removing the turbine rotor assembly. Inspection of the liner and hot section is via combustor inspection ports. Fuel nozzles and ignition assemblies are replaceable.

• **Nozzle diaphragm** assemblies can be replaced in the field. Split second-stage nozzle diaphragms are replaced by removing the split turbine stator assembly. Turbine wheel remains intact. Integral first-stage nozzle (structural support) can be replaced by removing turbine wheel assembly. Interchangeable turbine wheel assemblies permit removal and installation without affecting balance.

• **J85 turbine buckets** (moment weighted) and standard bucket-base tolerance permit complete interchangeability without rotor rebalance. Turbine wheel assembly can be unit-replaced by removing the turbine section. Separately balanced and interchangeable turbine rotors are rebalanced as assemblies. Interchangeable stages and torque rings require balancing. Pre-balancing of turbine disks is not considered necessary since bucket installation is the most significant balance criteria.

• **With afterburner separated** from engine, the flameholder, ignitors, fuel nozzles, and cooling shrouds are replaceable without further disassembly of the afterburner.

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Westland Delivers Wessex Helicopters to Royal Navy

London—First two production Westland Wessex helicopters for anti-submarine warfare use have been delivered to the Royal Navy's 700 Squadron for service trials. The aircraft, basically a Sikorsky S-58 powered by a single Napier Gazelle 13 gas turbine engine of 1,450 shp. (AW May 18, 1959, p. 98), has a military capacity of 5,000 lb. and carries advanced detection equipment and homing torpedoes. Wessex eventually will be fitted with automatic stabilization equipment. Later version, the Mk. 2, will be powered by two de Havilland Gnome turbines.

These no-draft Alcoa Forgings for F-104 save Lockheed 40 cents on the dollar

DORSAL FORMER
Precision forged by Alcoa to finished dimensions—with zero draft.

AIRSCOOP FITTINGS
Alcoa no-draft forgings with contours forged to various angles.

Take a close look at the *Dorsal Former* at left. Notice the thin, upstanding ribs. Alcoa forged this part to finished dimensions, *with no inside taper to machine off.*

Alcoa supplies Lockheed with many close-tolerance, untapered rib forgings. The *Airscoop Fittings* are sophisticated examples. In all, the F-104 carries 60 no-draft forgings. Lockheed estimates the average saving over conventional machined parts comes to 40 cents on the dollar.

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We mention the *Windshield Frame* above to point out our capabilities in other directions. This part measures 38 x 30 x 6 in. Wall thickness is 0.110 in. for 80 per cent of the casting area. This requires several sand and plaster cores which have to assemble and hold dimensions within ±0.03 in. across the joints. Casting must conform to fuselage contour within 0.015 in. To top it off, defects considerably smaller than a pinhead are cause for rejection.

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Here is Francis Alterman, Manager of General Mills Digital Computer Laboratory, checking one of our newest computers which he helped design. General Mills computers, both analog and digital, are being used in missile guidance, bombing and navigation systems, automatic surveying and in industrial control. In future space travel, computers will help control navigational systems of space vehicles and will process data gathered in outer space.

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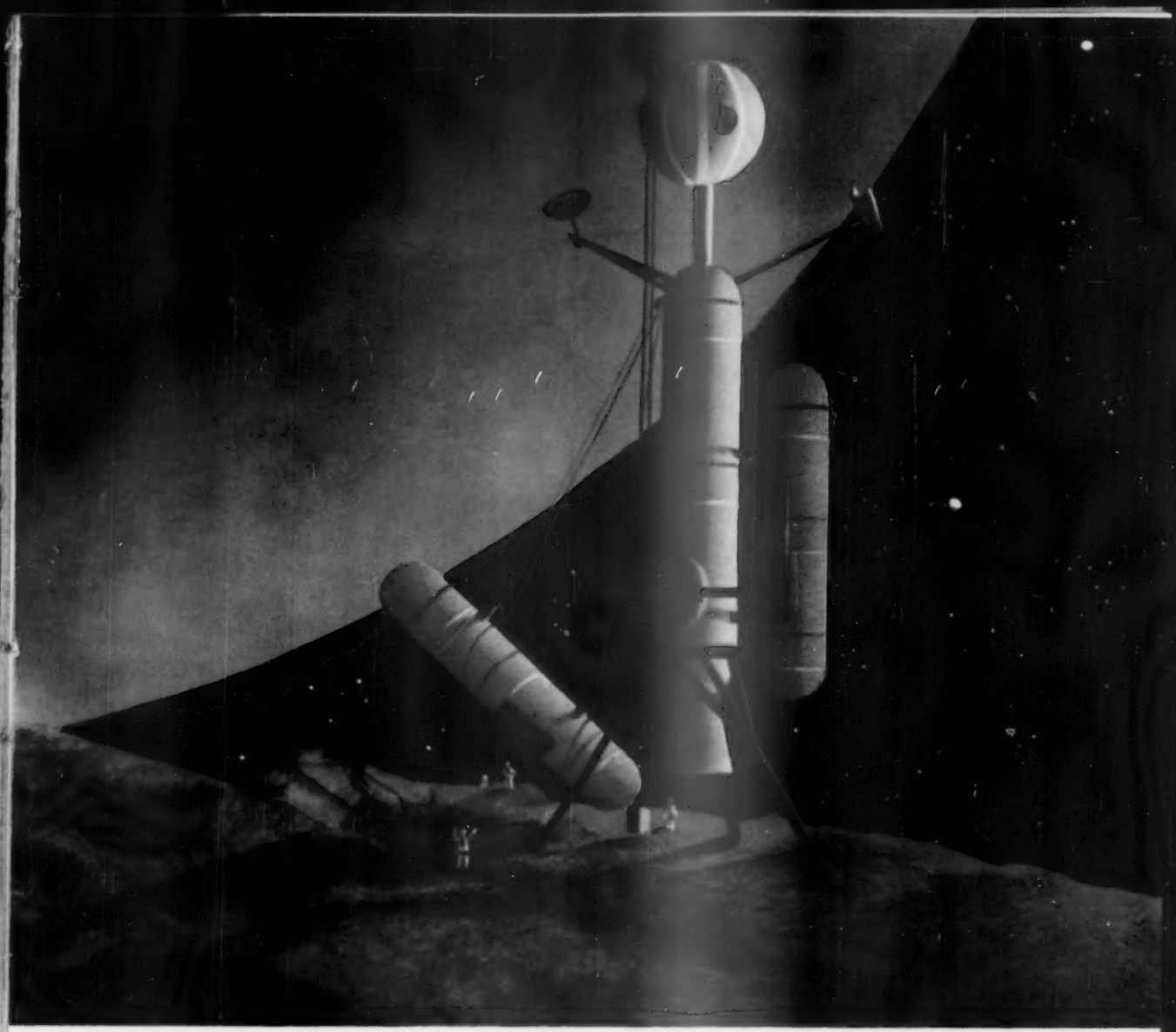
General Mills has been producing computers for nearly 20 years. Exciting new concepts in high speed magnetic tape units, ultra-high precision analog to digital converters and optical keyboards are examples of continuous developments in our over-all computer program. We work to improve reliability, increase speed, cut cost.

Our research activities cover broad areas in physics, chemistry, mechanics, electronics and mathematics. Some of the studies representative of these activities are: ions in vacuum, deuterium sputtering, dust erosion, magnetic materials, stress measurements, surface friction and phenomena, trajectory data and infrared surveillance.

In our engineering department, current projects include: specialized inflatable vehicles and structures, airborne early warning systems, micro wave radar test equipment,



Mars seen from one of its moons . . . illustration from book written for General Mills by Willy Ley.

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Auxiliary Gas Turbines becoming a prime power source for industry

Helmut Schelp, chief engineer, AiResearch Manufacturing Division of Arizona, Phoenix, surrounded by typical gas turbines now in production ranging in size from 30 to 850 hp. Clockwise from the top: GTC 85-25 GTCP 105 • GTP 70-6 • GTP 30-1 • GTP 70-10 • GTU 85-2.

AiResearch Gas Turbine Engines, the most widely used power source for the starting, air conditioning, cooling and heating of jet aircraft, now are becoming a prime power source for industry.

Easier to maintain because of few moving parts, these lightweight gas turbine engines develop more horsepower per pound of weight and size than any other engine. Achieving their greatest efficiency at maximum speeds, they run on almost any fuel and start immediately in any weather.

Present prime power applications of AiResearch gas turbines for industry: earthmoving equipment; small independent generator plants; marine use; helicopters and small conventional aircraft; emergency power plants; air conditioning, heating and refrigeration; atomic energy (closed cycle gas turbine with atomic energy heat source).

First to design and develop a successful small gas turbine engine, Garrett is the world's largest manufacturer of lightweight turbomachinery — having delivered more than 200,000 units, including 9000 gas turbines of all types ranging from 30 to 850 hp. Through its AiResearch Manufacturing Divisions, The Garrett Corporation is now offering this experience to all industry.

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PRODUCTION BRIEFING

Raytheon Co. Hawk missile system will become operational with the Marine Corps May 2 when the 1st Light Anti-Aircraft Missile Battalion is activated at Twentynine Palms (Calif.) Marine Corps Base. Helicopter-transportable battalion will comprise 24 launchers and 600 Marines grouped into four firing batteries, plus a headquarters and service battery.

Lear, Inc., Santa Monica, Calif., will build autopilots for the Caravelle jet transport under follow-on contracts with Sud Aviation. Contracts for the Caravelle's L-102 autopilot total $4 million.

Rohr Aircraft Corp. has received $11.5 million in follow-on orders for components for the Boeing 707 and 720 series (aft fuselage sections, pods and struts) and for the Convair 880 (pods and struts).

Light Military Electronics Department of General Electric has been awarded contracts totaling more than $4.5 million for follow-on production of AF/A42G-8 flight control systems for the Republic F-105D jet fighter-bomber.

First Convair B-58 Hustler unit, the 43rd Bomb Wing (Medium), has been activated at Carswell AFB, Tex. Unit will have 36 airplanes and a complement of about 1,800 officers and airmen in three squadrons.

Aeronca Manufacturing Corp., Middletown, Ohio, will continue production of its Pogo-Hi missile target drone under follow-on contract from the Army White Sands Missile Range. The Pogo-Hi, designed to test Nike, Talos, Sidewinder and Falcon missiles, is ground-launched to 80,000 ft. where the nose section, containing radar reflector and infrared emitter, separates from the engine.

Convair Division of General Dynamics, Pomona, Calif., will develop the Mauler surface-to-air missile under $5.5 million Army contract. The Mauler is a mobile solid-propellant weapon designed to intercept short range ballistic missiles and tactical support aircraft. The radar-guided missile will be fired from a single tracked vehicle.

Todd Ship Yards Corp., Houston, Tex., will construct a 180-ft. barge for transporting the Saturn space booster from Huntsville, Ala., to Cape Canaveral. The contract for the $344,800 barge from the Army Transportation Research Command calls for Oct. 1, 1960, delivery. The 2,200 mi. voyage, via the Tennessee, Ohio and Mississippi Rivers and the Gulf of Mexico and Atlantic Ocean coastal waters, is expected to take three weeks.

Solar Aircraft Co. has received a contract from Aerojet-General for fabrication of rocket motor cases for Navy's Eagle air-to-air missile.

National Research Corp. has formed a Space Vacuum Laboratory at Cambridge, Mass., for vacuum tests in missile and space programs. Dr. John C. Simons is director.

Northrop Corp.'s Nortronics Division will continue production of U. S. Army-Raytheon Hawk interceptor missile under contracts totaling $22,647,800. Work includes ground handling equipment production and research.

Collins Radio Co., Cedar Rapids, Iowa, received a letter contract for approximately $1.5 million in electronics systems for McDonnell F4H-1, North American A3J-1 and Grumman W2F-1 and A2F-1 aircraft. Included are UHF communications, Tacan and automatic direction finder navigation, radar identification, instrumentation and interphone systems.

HIGH-ALTITUDE PROBLEM—SOLVED BY CESSNA

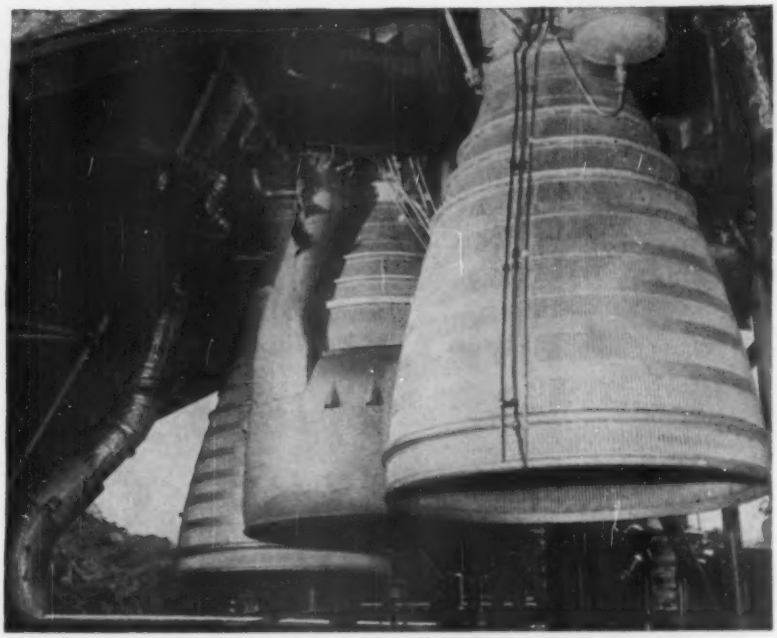
Problem: how to achieve, in a low-cost helicopter, capacity for high-altitude operations. Solution: the 270-HP supercharged Continental engine, airplane-like configuration, and aero-dynamically clean rotor assembly of Cessna's new high-performance CH-1C. Capable of hovering over the highest mountains in the U. S., the FAA-certificated CH-1C flies untroubled where winds, temperatures and density-altitude continue to deter most helicopters.

High-altitude capability is just one of the reasons the 4-place CH-1C is a highly practical aircraft—and one *more* of the ways Cessna "Problem-Solving" Research is ever at work enhancing America's future in the air.

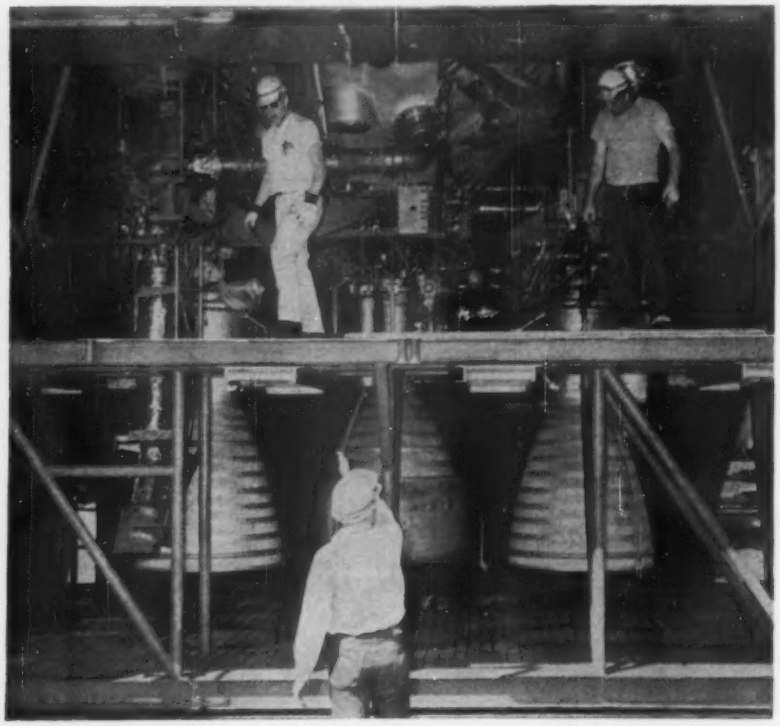
Military Division, Wichita, Kansas

CESSNA

Atlas Engines Pass Qualification Tests



ROCKETDYNE MA-3 cluster is the first intercontinental ballistic missile propulsion system to be qualified as a unit by USAF. The 60,000-lb.-thrust XLR105NA sustainer is in center, flanked by two 165,000-lb.-thrust XLR89NA-5 boosters. Duct at left is exhaust exit for heat exchanger turbopump for the far booster engine; one for right booster is barely visible. Exhaust for sustainer heat exchanger turbopump is ducted into the engine's exhaust nozzle shroud. Below, work stand is removed prior to firing.



By William S. Reed

Canoga Park, Calif.—The MA-3 propulsion cluster for the Convair Atlas-E recently became the first intercontinental ballistic missile powerplant to pass Air Force qualification tests.

Rocketdyne Division of North American Aviation completed the series of qualification tests in 19 days during which a total of 42 full-cluster runs were made. All five engines in the cluster operated satisfactorily on every run. Components of the MA-3 propulsion system, first cluster engine to be fully qualified before flight, are:

- **Higher-thrust XLR89NA-5** twin booster engines each develop 165,000 lb. thrust at sea level, up 15,000 lb. over the previous MA-2 booster. Boosters burn for about 145 sec.
- **Sustainer engine, XLR105NA-5,** generates about 60,000 lb. sea level thrust and burns for about 300 sec., continuing after the boosters are expended and drop away.
- **Vernier engines, XLR101NA-7** which control the Atlas in roll and yaw until ballistic trajectory is achieved.

Weight reduction of 100 lb. in the MA-3 cluster has been achieved mainly through the substitution of glass fiber for metal bands around the combustion chamber of the booster engines. Layers of the glass fiber are wound around the critical area and baked hard to serve as a strengthening material to contain the force of combustion.

Reduction of about 15% in the number of components to increase reliability and ease operational maintenance has been achieved partly as a result of a new control system which uses fuel from the missile's tanks to operate all engine sequences. In earlier models, pneumatic and hydraulic systems were used for these functions.

Qualification tests, MIL-E-5151, were conducted by Rocketdyne at its Santa Susanna facility on the five separate engines forming the MA-3 cluster. Qualification units were taken from the assembly line after appropriate acceptance tests had been performed. Acceptance tests consist of a minimum amount of running time designed only to check thrust alignment, perform necessary adjustments to the thrust vector and calibrate thrust to assure that specific impulse is above minimum. Mixture ratio also must be within 1.4% of nominal on the boosters and within 15% on the sustainer engine.

Qualification tests were run in two

separate categories—on individual components and on completed rocket engine assemblies. Complete engine assemblies were required to undergo a running time equivalent to 12 full-duration runs. Of the total time, six runs had to be of the duration specified for the engines in actual flight, but 11 runs actually were made. A total of 1,740 sec. operating time was required for each booster engine and 3,600 sec. for each sustainer engine.

Qualification tests on the MA-3 engine began on a test stand equipped for simulating extreme environments. Complete cluster was stored at 160F or higher at 95% relative humidity for five days. During the high-temperature storage phase, rocket technicians wearing specially insulated high-temperature suits entered the chamber and inspected the engines and components for external corrosion.

Immediately following high-temperature storage, the environmental chamber was removed from around the engines and a full-duration run conducted. Calibrations were conducted on each of the runs to ensure that specific impulse, mixture ratio and other performance parameters were not affected by the extreme temperature.

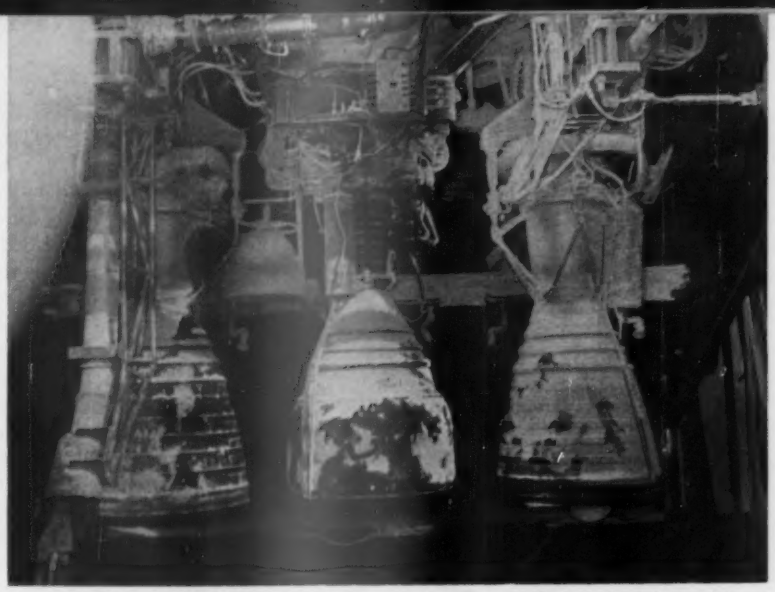
Temperature Lowered

Engines again were placed in the high-temperature and high-humidity chamber, and temperature was lowered to minus 65F and held for 24 hr. As rapidly as possible, the environmental chamber was removed from around the cluster and a full-duration run commenced. As in the high-temperature runs, performance parameters were checked for effects of the low-temperature soak.

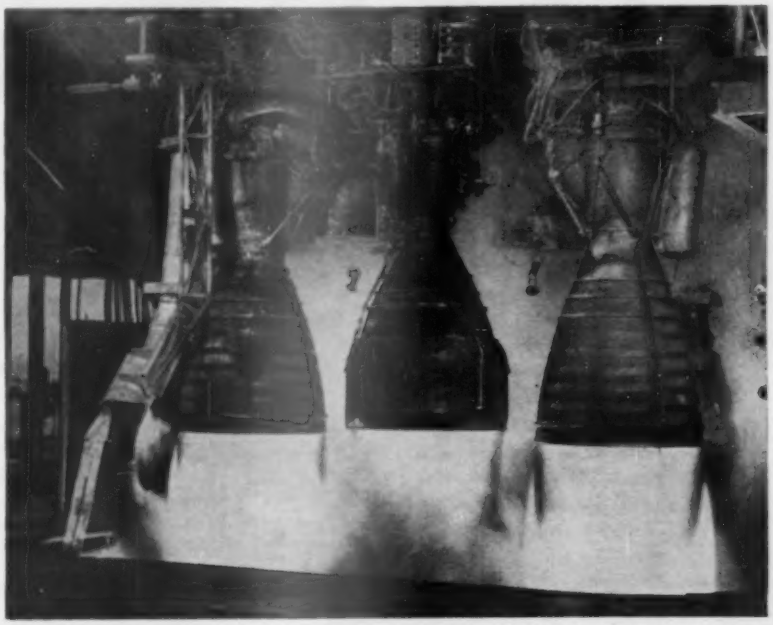
In addition to runs following extreme environmental conditions, two fixed gimbal runs and two operating gimbal runs also were made. Other characteristics demonstrated during the program were that sustainer mixture ratio stayed within plus or minus 15% of required limits—propellant was monitored during engine run to measure the flow of RP-1 and liquid oxygen, and this mixture ratio compared with a value for required thrust.

Mixture ratio of the propellant for the booster engines also was required to remain within 1% of nominal from run to run—without adjustment to the mixture ratio control, mixture could not vary more than 1%. Booster and sustainer thrusts also were calibrated during each run to determine if these were greater than plus or minus 3% from nominal. Specific impulse also had to remain above the minimum set on every run.

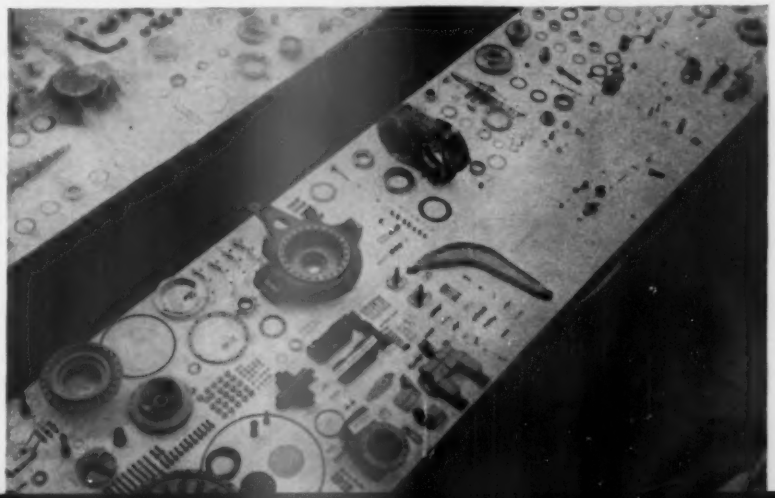
During the calibration series a total of 19 runs were recorded on booster No. 1, 20 on booster No. 2, and 18



ENVIRONMENTAL CHAMBER has been removed from around the MA-3 cluster (above) after cluster was exposed to 160F in 95% humidity for five days followed by cold soak at minus 65F for 24 hr. Cluster is fired (below) as soon as the environmental chamber is removed. Ice is shown being shaken from the cluster two seconds after ignition.



FINAL PHASE of the qualification test program is disassembly (below) of the test cluster and inspection of all parts so the extent of wear during the tests can be determined.



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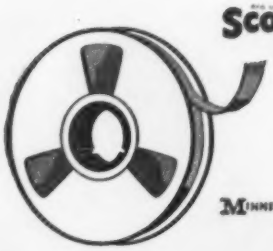

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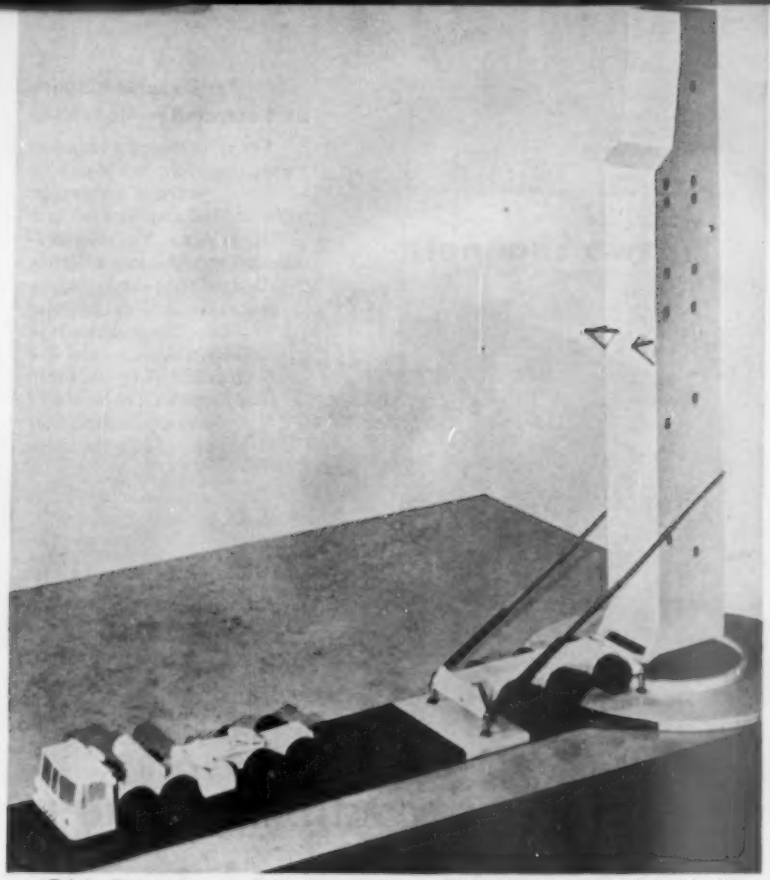

GM Displays Minuteman Transporter Model

Mobile transporter-erector model for the Minuteman intercontinental ballistic missile is shown poised over a silo hole, ready to lower the ICBM into position (AW Mar. 7, p. 137). The concept was developed by General Motors Corp. (prime mover and rear bogie), Cessna Aircraft Corp. (missile container) and Bendix-Pacific Division (hydraulic hoist system). Environment within the container is controlled. The transporter-erector is 63 ft. long and weighs about 108,000 lb. when hauling the Minuteman. A harness has been designed to automatically adjust to various stage diameters.

runs on the sustainer engine. Simultaneously with the actual calibration series, a safety limits test series was conducted to demonstrate safe engine start, operation and shutdown with the following malfunctions deliberately programed:

- **High and low pressurization** of both the main liquid oxygen and main fuel tanks. Over-pressurization applied to the tanks was approximately 10%. Low pressurization value was below the specified net pressure suction head. Vernier engine operation also was demonstrated with solo tanks both over-pressurized and under-pressurized.
- **Auxiliary power discrepancy** resulting from low hydraulic and pneumatic pressures was investigated, as well as high and low d.c. voltage in the electrical system.
- **Mixture ratio variations** beyond that required by MIL-E-5151. Sustainer mixture ratio of plus or minus 18% of optimum and booster mixture ratio of plus or minus 10% were tested and determined to be within safe operating limits. Additional stop-start reliability tests were conducted, bringing to 23 the total number of tests during the safety limits series.

Thrust chamber assemblies and power controls separately were subjected to individual tests. Chamber assemblies were calibrated and then given two runs at 90, 95, 100, 105, and 110% of full thrust for full duration. Chambers also were given one full-duration and one short-duration run following high-temperature soak, and two runs of sufficient duration to stabilize temperatures following low-temperature soak at minus 65F. Assemblies also were subjected to salt spray, washing, and sand and dust.

Power controls and subcontrols were subjected to extreme environmental tests—static leakage, washing, salt spray, sand and dust, and power control subunits were calibrated to determine the effects.

Qualification test engines were returned to the Rocketdyne plant and completely disassembled for inspection to determine the extent of wear during the tests.

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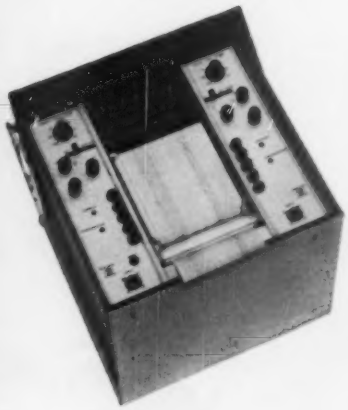
MINNESOTA MINING AND MANUFACTURING COMPANY ...WHERE RESEARCH IS THE KEY TO TOMORROW 3M

keep an accurate graphic record

OF RESEARCH, DESIGN, TEST DATA

two channels



For General Purpose DC Recording — Model 320

For recording *two variables* simultaneously, the Model 320 provides a versatile, transistorized amplifier for each input signal. The rugged 2-channel recorder assembly has heated stylus recording on two *50 mm wide* rectangular coordinate channels, 4 pushbutton chart speeds, and 6 inches of visible chart. The Recorder can be placed vertically, horizontally or at a 20° angle.

MODEL 320 SPECIFICATIONS

Sensitivity: 0.5, 1, 2, 5, 10, 20 mv/mm and v/cm
Frequency Response: 3 db down at 125 cps, 10 mm peak-to-peak
Common Mode Voltage: ±500 volts max.
Common Mode Rejection: 140 db min. DC
Calibration: 10 mv internal ±1%
Output Connectors for each channel accept external monitoring 'scope or meter
Price: $1495

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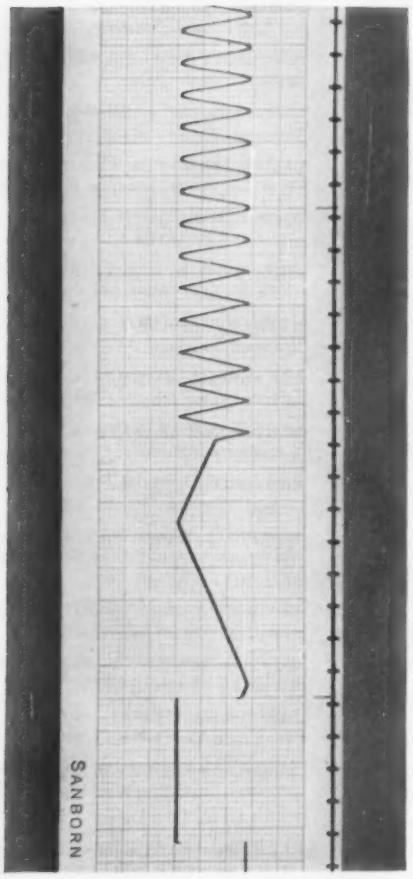

Two models of this 21 lb. brief case size recorder are available — Model 301 for AC strain gage recording, Model 299 for general purpose DC recording. Both provide immediately visible, inkless traces by heated stylus on 40 division rectangular coordinate charts . . . frequency response to 100 cps . . . 5 and 50 mm/sec chart speeds . . . approx. 4 inches of record visible in top panel window.

single channel

MODEL 301 SPECIFICATIONS

The amplifier section of the Model 301 is an all-transistorized carrier type with phase sensitive demodulator. The power supply and internal oscillator circuits are also transistorized.
Sensitivity: 10 uv rms/div (from transducer)
Attenuator Ratios: 2, 5, 10, 20, 50, 100, 200
Carrier Frequency: 2400 cps internal
Transducer Impedance: 100 ohms min.
Calibration: 40 uv/volt of excitation
Output Connector: for external monitoring 'scope or meter
Price: $750

MODEL 299 SPECIFICATIONS

Combines the dependability of transistors with the high input impedance of vacuum tubes for reliable broad-band DC recording.
Sensitivity: 10, 20, 50, 100, 200, 500 mv/div and 1, 2, 5 and 10 v/div
Input Resistance: 5 megohms balanced each side to ground
Common Mode Voltage: ±2.5 volts max. at 10 mv/div sensitivity increasing to ±500 volts max. at other sensitivities
Common Mode Rejection: 50:1 most sensitive range
Calibration: 0.2 volt internal ±1%
Output Connector: for external monitoring 'scope or meter
Price: Model 299 (with zero suppression) $700
Model 299A (without zero suppression) $650

All prices are F. O. B. Waltham, Mass., within continental U. S. A. and are subject to change without notice.

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TEST STAND for NASA-Rocketdyne F-1 1.5-million-lb.-thrust engine was designed primarily by a division of Aerojet under Army contract.

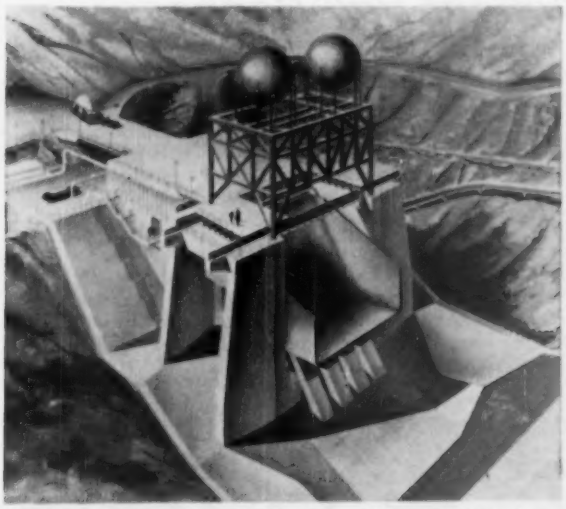
Aerojet Designs 1.5-Million-lb. Test Unit

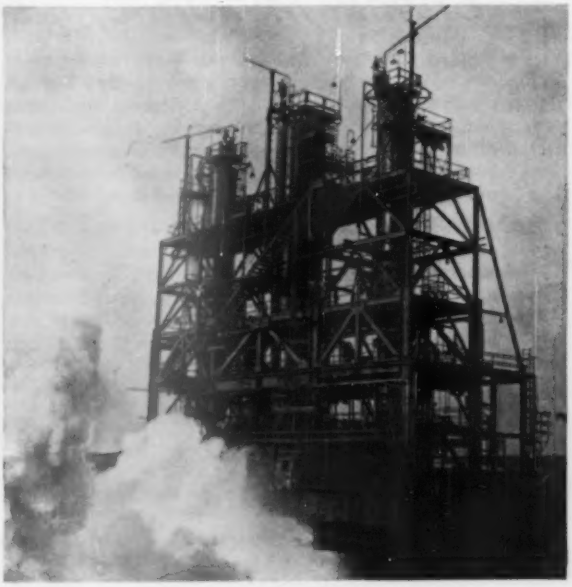
Edwards AFB, Calif.—Test stand here designed to accommodate two 1.5-million-lb.-thrust single chamber liquid fuel rocket engines simultaneously is more than 10% complete, with construction scheduled to be completed Oct. 1.

Foundations and deflector supports of the stand, which was designed by the Aetron Division of Aerojet-General Corp., are stressed for static testing of engines totaling 6 million lb. thrust.

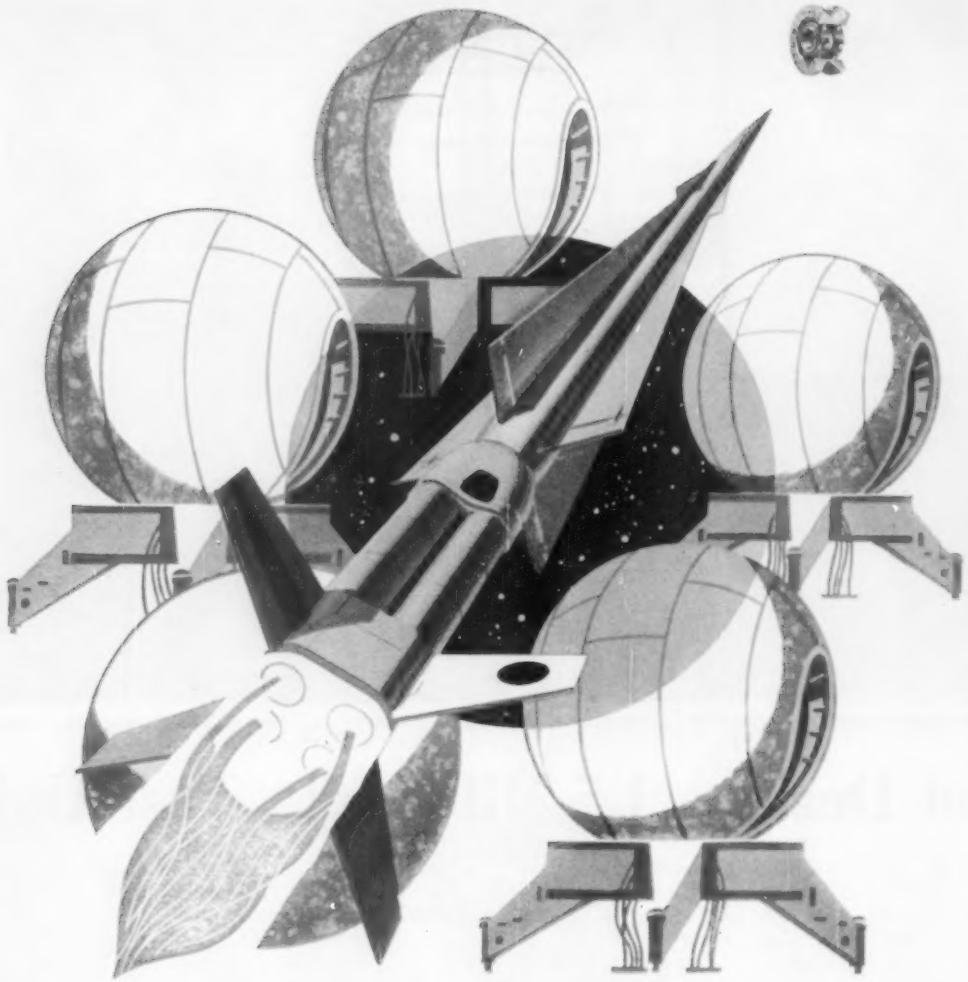
Strengthening of the stand's superstructure will be required to handle engines of this size when they reach the firing test stage.

The test stand, designated 1-B, is under construction by the Army Corps of Engineers for the Air Force, and the major unit to be tested in it is the 1.5-million-lb.-thrust single chamber F-1 engine being developed for National Aeronautics and Space Administration by the Rocketdyne Division of North





COMPLETED 1-B test stand is shown in artist's conception above. At right, the liquid fuel engine is being test fired at Aerojet-General's Sacramento facility.



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N/D Designs Assembly Savings Into Critical Miniature/Instrument Ball Bearings!

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A timely example of N/D customer assembly savings can be seen in Nike Ajax and Hercules missile ground support. Here, *special* N/D Instrument ball bearings are now used in precision potentiometers. New Departure engineers recommended eliminating two *single row* instrument bearings, mounted in duplex and requiring precision spacer and separate guide roller. They replaced this assembly with a *special* N/D *double row* high precision instrument ball bearing with integral outer race guide roller . . . and shaft mounted with a nut. This one recommendation produced cost savings of over 400%! In turn, the customer was able to reduce the potentiometer selling price to the government. What's more, the New Departure Instrument Ball Bearings improved potentiometer reliability!

You can look to minimum assembly costs and unsurpassed *reliability*. Include an N/D Miniature/Instrument Bearing Specialist in your early design level discussions. For immediate information or assistance, call or write Department L.S., New Departure Division, General Motors Corporation, Bristol, Connecticut.

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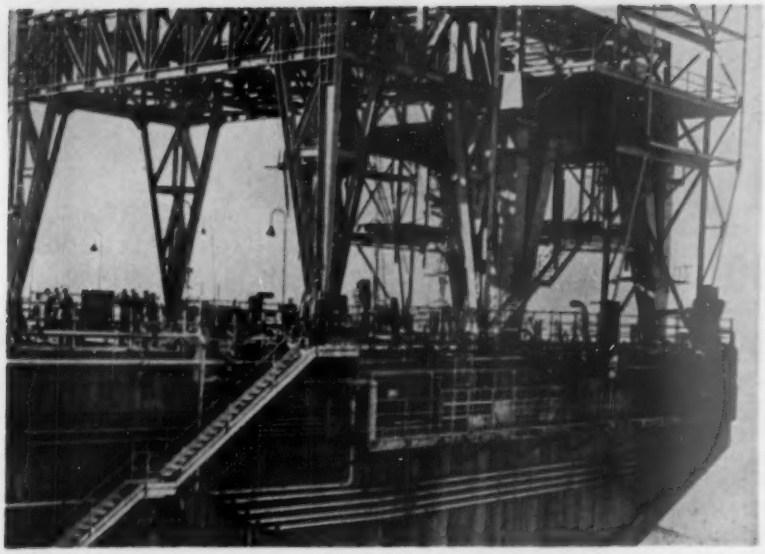

ERECTION of steel superstructure of test stand at Edwards AFB for the F-1 engine is largely complete, but internal instrumentation will not be finished for several months.

American Aviation, Inc. Concrete portion of the structure is approximately 125 ft. high and contains 12,000 cu. yd. of concrete. The steel superstructure supports the propellant tanks and the engines, and it, in turn, is bolted to large bearing plates on top of the concrete foundation. These plates are secured to the foundation through several long prestressed steel cables so that structural deflections during test firings will be kept to a minimum.

Condition of the test stand as well as the performance of the rocket engines under test will be recorded during each firing. Strain gages in the foundation and the exhaust deflector plate unit will be monitored to see that allowable stresses are not exceeded. Altogether, 600 circuits will be provided for engine and test stand data.

Water Pressure

Liquid handling systems on the stand will be several times larger than those on test stands now in use. About 450,000 lb. per min. of water will be expelled at high pressure down the exhaust deflector plate to keep it from becoming too hot, and propellants will have to be supplied at the rate of about 700,000 lb. per min. when two F-1 engines are firing at once.

The 1-B test stand will be tied into the existing control center currently used with an existing test stand. A 780 ft. tunnel will connect this stand with 1-B.

Aerojet's Aetron Division, headed by B. F. Rose, Jr., is an outgrowth of the company's Architect-Engineer Division.

It is interested in electronic nuclear design as well as the design and construction of large manufacturing and test facilities.

In addition to the new unit at Edwards, Aetron has designed more than 37 test stands in 10 locations capable of firing engines of 50,000 lb. thrust and more. This group includes the Missile System Test Stand at Redstone Arsenal at Huntsville, Ala., which is rated at 1.5 million lb. thrust.

Army Studies Radar For Missile Detection

Los Angeles, Calif.—Experimental program to determine the efficiency of radar in the detection and identification of ballistic missile warheads will be conducted on the Pacific Missile Range. Project Press (Pacific Range Electromagnetic Signature Study) is part of Advanced Research Projects Agency's Project Defender series.

Services and support functions will be provided by the range for the project. Responsibility to carry out the experiments has been assigned to Army Ordnance Missile Command's Rocket and Guided Missile Agency.

A special radar installation is planned at Roi Namur Island in the Marshall Islands, 45 mi. from the Army's Nike Zeus installation on Kwajalein Atoll. Experiments will be conducted with unarmed target missiles which the Army plans to launch from Johnston Island, 1,402 mi. from Roi Namur.

Similar program has been under way for more than a year for missiles fired from Atlantic Missile Range, using the USS Mariner, operated by Radio Corporation of America for the Army under ARPA sponsorship.

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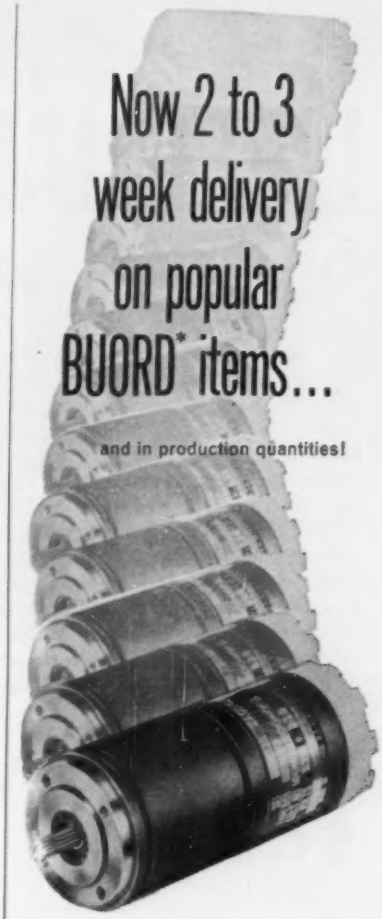

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The vital Cape Canaveral nerve center for Project Mercury, the U.S. program to put a man in space, is being designed and built by Stromberg-Carlson-San Diego. Display information about the flight will be fed to the operations room from computers and from a world-wide network of tracking and telemetry stations. One wall of the 40 by 60 ft. operations room will be a large map display, visually summarizing all pertinent information about the flight. It will show the capsule moving along its orbital flight path around the earth and will also show the location, range and status of all ground based equipment and communications links. The operations room will contain display consoles presenting information to the Flight Director, Chief Flight Surgeon, Capsule Communicator, Flight Dynamics Officer and other decision-making personnel. For information on how Stromberg-Carlson-San Diego can help solve your data/display problems, write to Department A-38, 1895 Hancock Street, San Diego 12, Calif. Telephone CYpress 8-8331.

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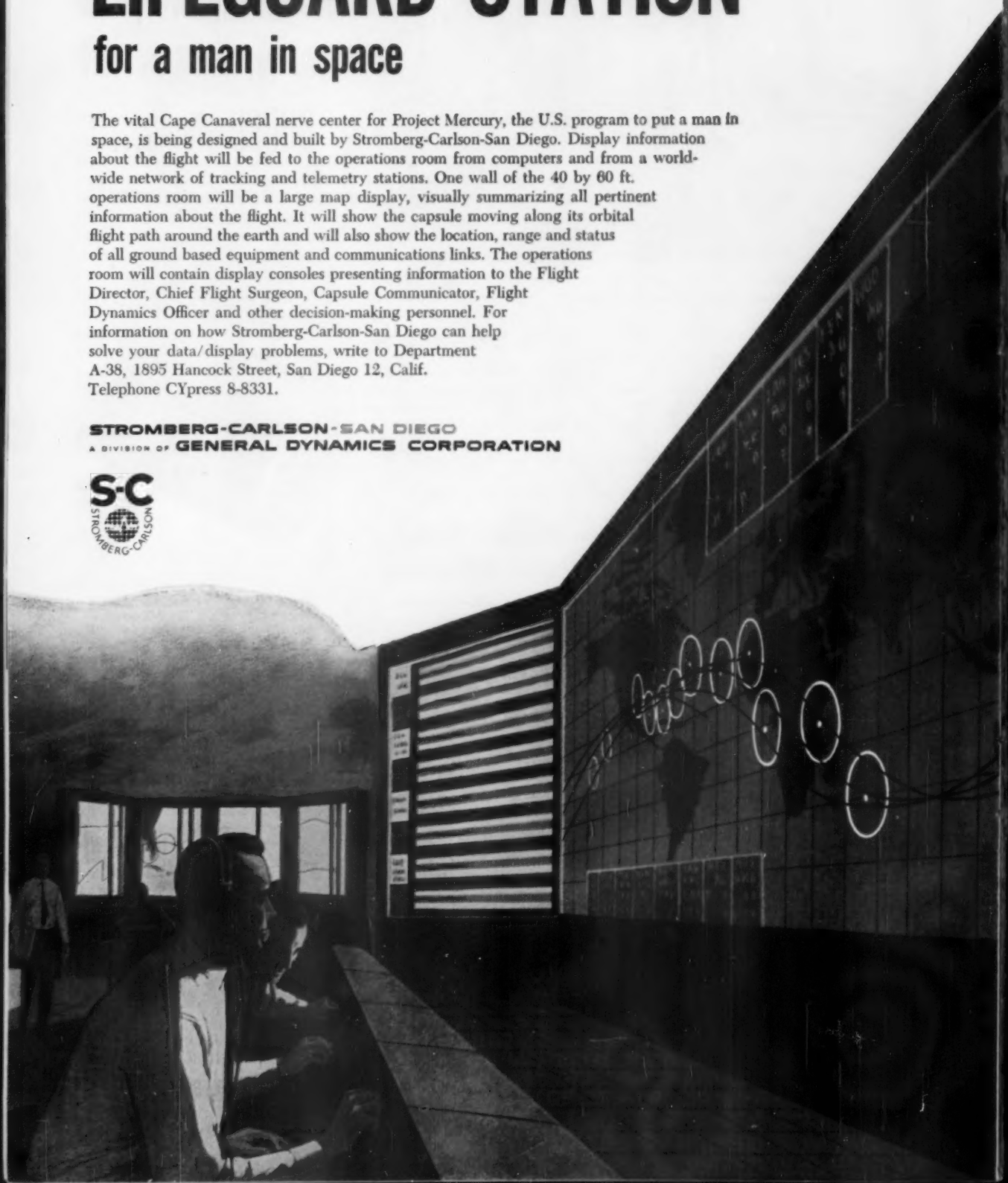
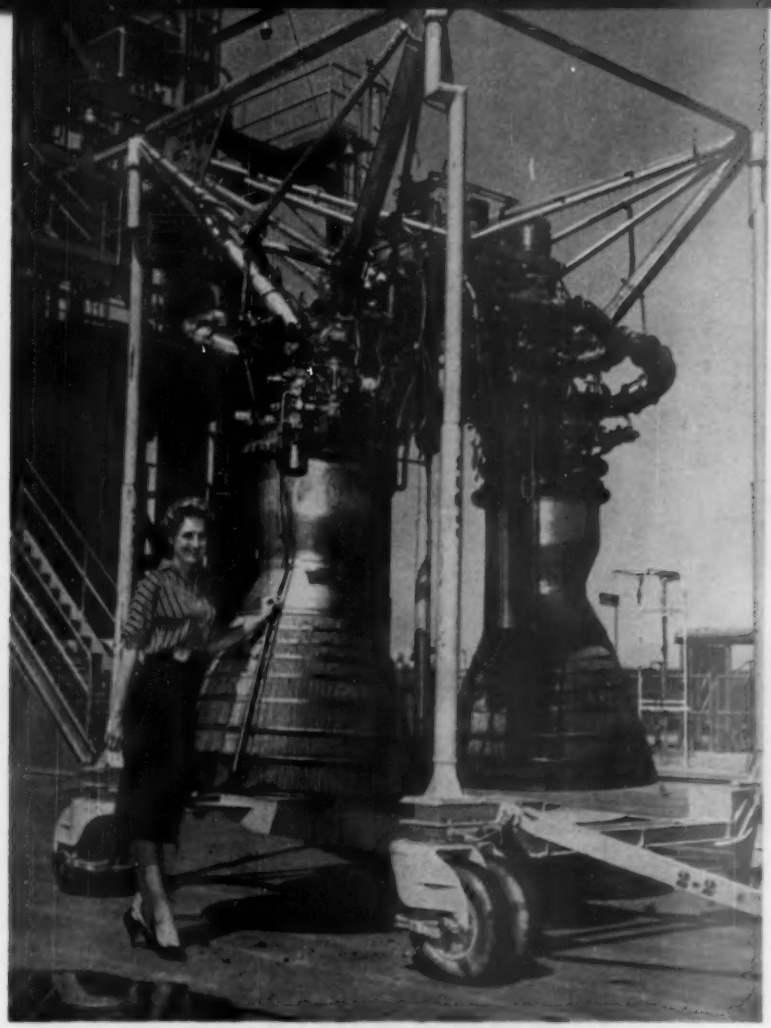
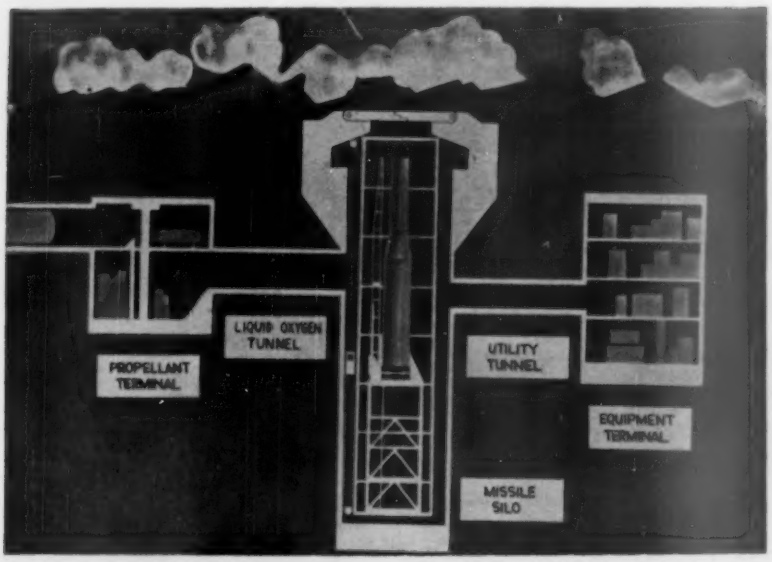




Titan Hard-Base Tests Planned This Year

First-stage Aerojet-General LR-87 engine for USAF-Martin Titan intercontinental ballistic missile produces 300,000 lb. thrust (AW Aug. 24, p. 26). Drawing below shows silo lift launcher that will be typical of those at all Titan underground bases. First in-silo test firings will begin this year. Underground blockhouse (AW Nov. 30, p. 28), which is part of the hardened base, is not shown. Elevator lifts Titan to surface for firing.



ENGINEERS

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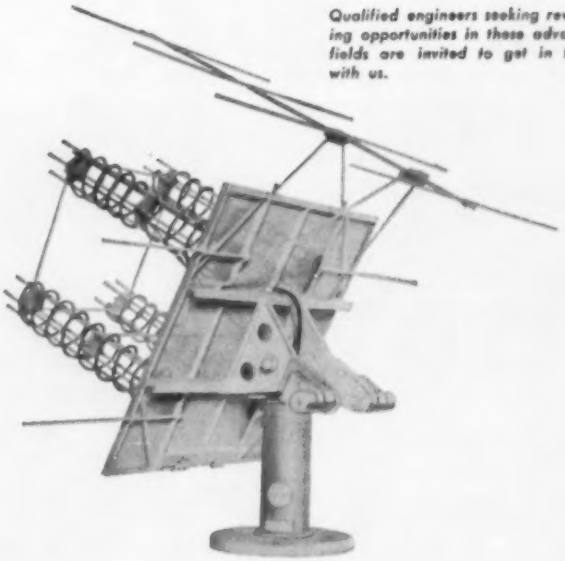


REEVES INSTRUMENT CORPORATION • *A Subsidiary of Dynamics Corporation of America* • Roosevelt Field, Garden City, New York

POLARIS submarine, the atomic-powered George Washington, carries 16 missiles in tubes aft of conning tower (AW Jan. 11, p. 32).

Navy Opens First Polaris Support Plant

By Craig Lewis

Charleston, S. C.—Navy has opened a $27.5 million Polaris depot here to assemble components into missiles and load them on fleet ballistic missile submarines. Facility is the Navy's link between the production line and the fleet.

Naval Weapons Annex is the first facility built to handle Polaris assembly, maintenance and loading. Missile components arrive here in 14 different parcels from Polaris contractors, and a mixed Navy-contractor crew is inspecting them, assembling them into warhead, guidance and two rocket stage packages, then storing them. As submarines go into service later this year, the missiles will be assembled, armed with their thermonuclear warheads and loaded into the submarines' 16 launch tubes.

Navy built its Polaris plant near the Naval Ammunition Depot here because it cost less to build than other proposed Atlantic Coast locations. It also is close to the Charleston Navy facilities which will be used as a home port by the USS George Washington and Patrick Henry and the FBM tender USS Proteus. Annex cost $10.5 million to build and $16 million to equip.

NWA is seven miles up the Cooper River from Charleston Harbor and has the advantages of access to the sea and an ice-free port. It is just north of the ammunition depot with its 1,000 ft. pier, and FBM ships will be able to sail up a newly-dredged four mile channel to the pier for missile loading.

As Polaris enters the final stages of its test program leading to operational status at sea next fall, the weapons annex will be assembling and checking out some of the instrumented test vehicles to be used, including the instrumented missile each new submarine will fire as part of its training and test program.

Polaris prime contractor, Lockheed Aircraft Corp., has a crew of 87 stationed here to supply technical advice to the Navy as it develops its capabilities for handling the missile. This Lockheed group is complemented by subcontractor personnel. As Navy acquires experience with the missile system, the contractor group will be reduced, probably reaching a minimum about mid-1961.

Weapons annex includes six buildings concerned with handling the missile system, plus 36 magazines spread over the 880 acre facility for storing motors, assembled missiles and warheads. The Annex also has a network of roads and railroads, housing facilities and utilities.

Contractors deliver such parts as guidance systems, hydraulic packs and other non-dangerous components to the 24,300 sq. ft. Inert Processing Building where they are inspected and stored until needed. Test equipment includes two General Electric guidance checkout computers, which simulate the fire control system, and a Nortronics automatic missile checkout set.

Aerojet-General solid propellant engines are inspected in the 5,489 sq. ft. Motor Processing Building, which has radiation, boroscope, ultrasonic and pressure inspection equipment, then they are sent to storage or to the assembly building, depending on requirements.

Warheads and re-entry bodies are inspected and assembled in the 3,302 sq. ft. Re-Entry Body Assembly Building. Warheads are stored separate from the assembled missile.

Container Repair Building is used to store and maintain the shipping and handling equipment for Polaris. Equipment Building handles upkeep of support equipment.

Polaris is assembled in the 14,962 sq. ft. Missile Assembly Building. Here, such inert parts as the GE guidance system are joined to the two rocket stages and the missile is assembled with everything but the warhead. The building has two GE guidance checkout computers and five missile checkout sets for its three assembly lines. Checkout process will be automatic and will take four minutes when all the equipment is installed. Checkout set runs the Polaris checkout automatically, including instructions to the guidance checkout set, and it analyses results.

During assembly, the completed missile, minus warhead, is installed in a container for storage. This container holds the missile in magazine storage or is installed in a second container for

Polaris Mixing Process

Washington—Navy and Aerojet-General Corp. have developed a continuous mixing process for Polaris solid propellant that is termed cheaper, safer and capable of more uniform quality than previous methods. Unlike the former batch mixing method in which 2,200 lb. batches were mixed at one time, the new continuous processing system is preparing only 20-25 lb. of propellant at a given time. System permits continuous testing of propellant quality.

ON THE LINE:

TRAINERS FOR A MACH 2 NAVY

With ever a watchful eye on the taxpayer's dollar, the Navy is quick to utilize any system that will save training time, costs, accidents. Such a system is the 500 mph T2J Buckeye jet trainer, designed and built by the Columbus Division of North American Aviation.

From primary training right up through carrier indoctrination—that is the philosophy and concept of the T2J. By combining multiple training stages "under one roof," the T2J produces pilots for Mach 2 combat planes in the same time as it took to train them for the 360 mph fighters of World War II.

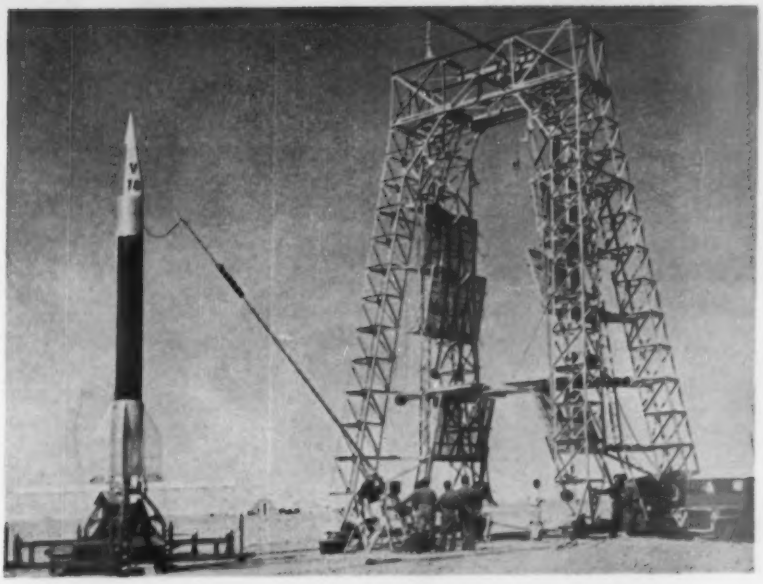
Sophisticated planning makes the T2J a favorite with ground crews as well as with the men who fly her. Related consoles and systems are located on the same side of the fuselage for easy trouble-shooting—AC systems on one side, and DC on the other. Components are shelf-mounted for instant interchangeability, and engine exchanges can be accomplished in less than 30 minutes.

An outstanding safety feature of the T2J is its rocket-catapulted escape system which functions regardless of speed or altitude, and which has already saved lives in the service.

As an aircraft of diverse talents, the T2J "all-in-one" trainer was expressly conceived to support the prime factor in Naval air power for years to come: the manned weapons system.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Columbus, Ohio



Veronique Attains 130-mi. Altitude

Veronique, French research missile, recently attained 130-mi. altitude in tests at Colomb Bechar in the Sahara. Maximum altitude is 145 mi. The 21-ft. vehicle is initially guided by four cables which uniformly unwind from a drum located under the platform from which the missile is fired. Outriggers extending from the rocket's fins receive these cables and maintain stability until upward motion is sufficient to allow aerodynamic forces to act on the control surfaces. Vehicle is scheduled to be used in studies of propagation of electromagnetic waves at high altitudes. Veronique is used to sample wind velocity, barometric pressure and temperature at altitude. It has been used to eject sodium clouds.

shipping overseas, to Cape Canaveral or elsewhere. Storage magazines have controlled environments, but the container also has individual capability for controlling its internal environment. Warhead is installed and stored in a separate container. Container and warhead are attached to the missile and its container when the complete missile is checked out for submarine loading.

The Weapons Annex must keep at least 16 missiles ready to load quickly when a submarine arrives at the loading pier. Time when the submarine is moored and an easy target must be kept at a minimum.

Weapons Annex has a flexible transportation system. Components can be received by rail or truck, or they can be airlifted and unloaded at a special pad isolated from other facilities at Charleston Municipal Airport. After the missile is assembled, it can be carried by rail or truck to the pier for loading with a new $551,000 portal crane.

Missile is swung onto the ship in its container. Container is fitted over the submarine launch tube, and the missile is lowered into the tube with equipment contained in the missile. Missiles can also be loaded on submarine tenders from the pier.

These tenders will supply Polaris subs at sea, and will be able to load missiles under relatively calm sea conditions.

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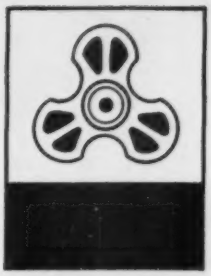

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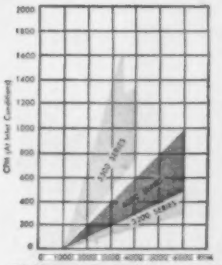
The unique combination of precision manufacture and modern design found only in M-D rotary positive blowers permits higher speed operation and higher pressures. For this reason M-D can furnish greater air flow at lower initial cost.

M-D blowers operate at wider pressure and speed ranges than any other rotary positive blower. Capacities of 22 production models range from 50 to 4,000 CFM, pressures to 14 PSIG single, 70 PSIG multi-stage.



CAPACITY CURVES FOR 12 PSIG DELIVERY PRESSURE

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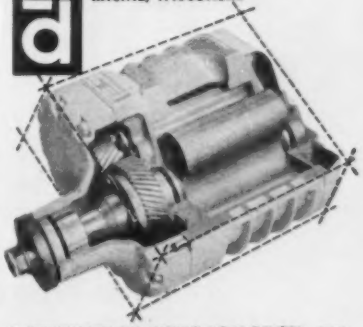

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AN ACHIEVEMENT IN DEFENSE ELECTRONICS
WHAT'S BEHIND A BMEWS RADAR?
Years of experience—for as early as 1954, General Electric had conceived and developed radar equipment capable of detecting ballistic missiles at 1,000 miles. This was the forerunner of the AN/FPS-50 surveillance radar being provided by General Electric under subcontract to RCA for the Air Force Ballistic Missile Early Warning System (BMEWS).
The AN/FPS-50 radar equipment, with a range in excess of 2,000 miles, is a singular example of achievement in defense electronics. It is another milestone in General Electric's sustained engineering effort to develop and produce equipment to meet the unprecedented detection problems posed by ICBM's.
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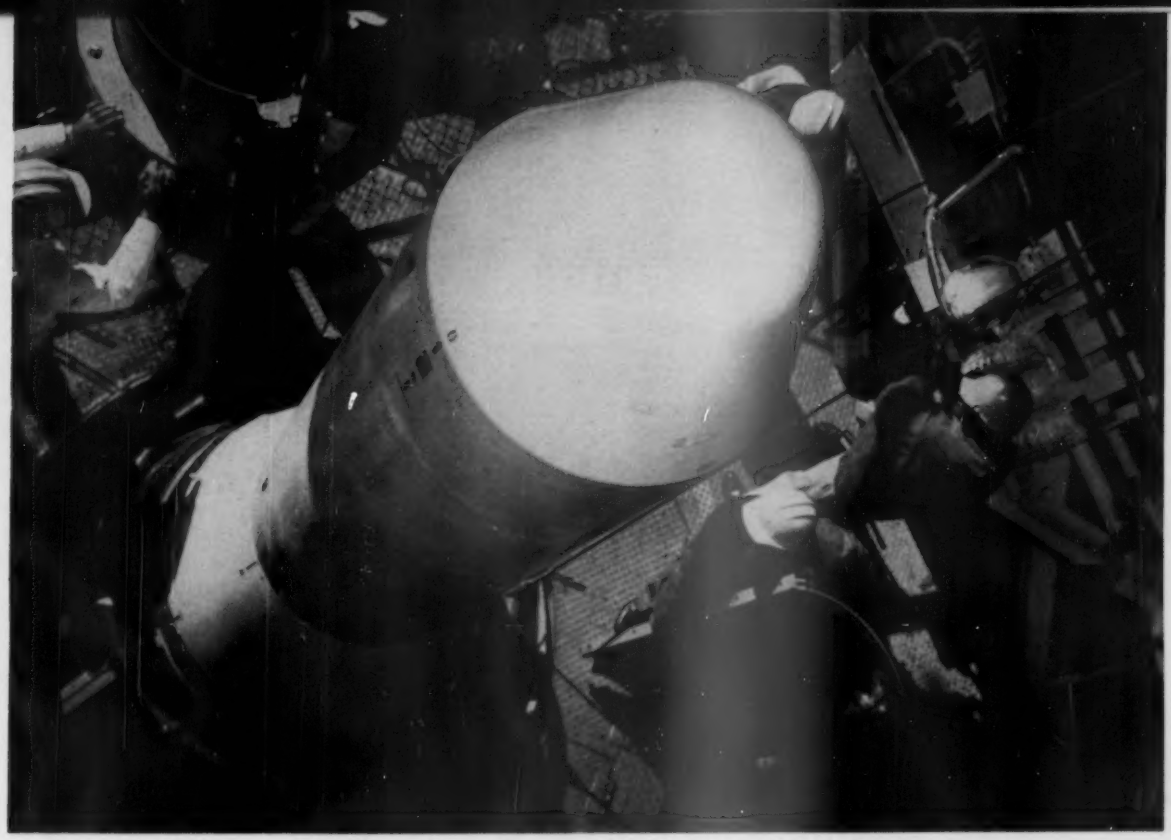

First flight of Avco RVX-4 materials research re-entry vehicle was made Jan. 26 on Atlas 44 D from Cape Canaveral, Fla.

Avco RVX-4 Re-Entry Vehicle First Launched on Atlas 44-D

Avco RVX-4 materials research re-entry vehicle is a forerunner of the Mk. IV operational nose cone originally programed only for USAF-Martin Titan. Test vehicle flew on Titan G-models Feb. 24 and Mar. 22. Avco data cassette, including tape recorder, power supply, flotation balloon, skirt parachute, dye marker, shark repellent, Sarah beacon transmitter and flashing light was ejected at supersonic speed and recovered on both flights. Avco is developing Minuteman re-entry vehicles.

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ON GLIDE PATH..."

NEW GILFILLAN "TALKING RADAR" TAKES THE GUESS OUT OF JET LANDING GUIDANCE

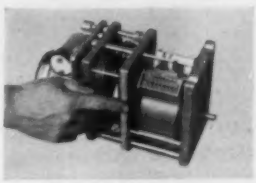
Supersonic jet speeds leave no margin for error inevitable when a radar operator must visually estimate aircraft position, decide guidance required and communicate three-dimensional data to the pilot.

The solution: New Auto Voice GCA – Gilfillan's new "talking radar" that is also a "thinking radar."

Through every moment of landing approach, Gilfillan Auto Voice GCA Radar computes precise aircraft position with infallible electronic accuracy... selects required data from a standardized R/T voice drum... transmits this guidance to the pilot instantly, including instant warning and course correction should the jet begin to deviate from safe approach limits.

The pilot is assured the infallible, accurate, instantly delivered guidance that is vital for jet operation. The radar operator monitors the approach, with undistracted readiness to communicate directly to the pilot in the event of any emergency.

Gilfillan Automatic-Voice GCA Radar eliminates one more problem of the human equation in the jet age.



30-TRACK VOICE DRUM

Includes pre-recorded standardized R/T commands on 27 tracks; 3 spare tracks for recording data needed at an individual location. Also has multilingual capability.

GILFILLAN FORESIGHTED PLANNING SAVES TIME AND TAX DOLLARS

Aircraft, missile, and space vehicle design is advancing so rapidly that ground electronic systems produced to meet current needs are in the process of becoming obsolescent at the time of installation.

The cost of replacement of such systems in terms of tax expenditures is self-evident. Less evident, equally important, is the cost of new development and production, new installation, new operator training and new spare parts.

Only experienced, foresighted research and development and on-time production can stay ahead of jet and space age advances. Gilfillan's on-time record is outstanding. Gilfillan ability to design for planned non-obsolescence is recognized, and proven many times over.

One example is Gilfillan Auto Voice GCA – an *accessory* to flexibly designed Gilfillan GCA Radar systems in operational use throughout the world since 1944. New Auto Voice adds jet-age capacity to these *existing and proven* GCA systems – in minimum time, at minimum cost, and with minimum changes in training and spare part supplies.

Gilfillan's experienced, foresighted planning is available for complete research, development and production in the fields of Air Navigation, Electronic Countermeasures, Missiles Systems and Instrumentation, Radar Trainers and Ground Support Systems.

GILFILLAN DESIGNS FOR PLANNED NON-OBSOLESCENCE

Multi-aircraft automatic-voice computer.

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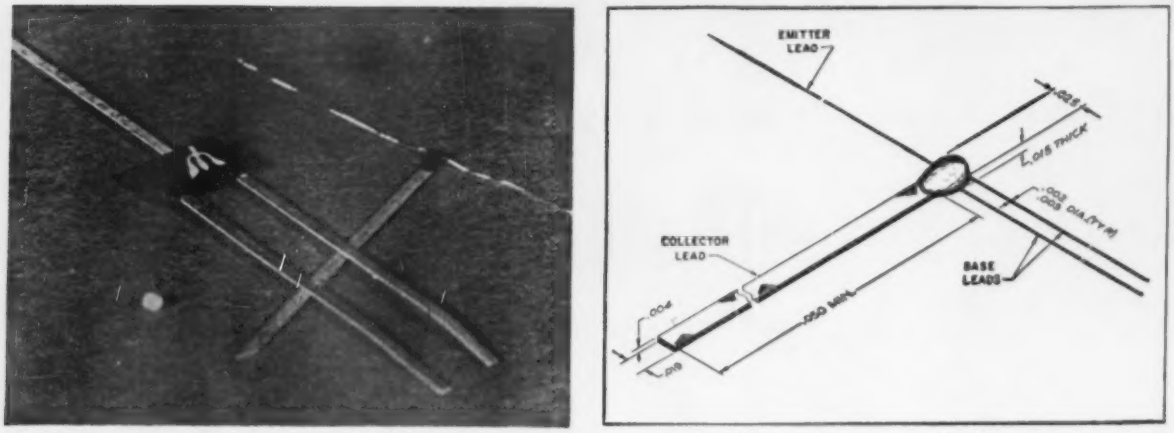


MICRO AND PICO surface passivated microminiature transistors, left and right, respectively, (left) are compared with single grain of common table salt. Dimensions of the smaller pico transistor are shown (right). Both transistors are in development at Pacific Semiconductors, Inc. Specifications on the pico will be issued by Pacific later this week.

Smaller Transistors Will Be Introduced

By Barry Miller

New York—A new generation of sealed microminiature transistors intended for use with many of the high component density packaging techniques being proposed for airborne computer systems will be introduced to the avionics industry during the remainder of this year.

These components are expected to satisfy a growing need for smaller transistors created by the trend toward wafer or substrate type microcircuits for which standard-size encapsulated transistor packages are too large or too bulky. They will be electrically identical counterparts of larger size transistor types now on the market. As such, these new transistor packages, smaller than the TO 18 case regarded as the smallest package generally available in the industry, may find extensive applications during the next two years. The latter interval is optimistically regarded as the transition period between present component packaging concepts and the anticipated solid-state or molectronic circuit.

Spacing Limited

Transistor can size frequently limits the minimum spacing between layers of components in the microcircuit programs, whether they be the various two-dimensional schemes of Diamond Ordnance Fuze Laboratories (AW June 16, 1958, p. 243) or International Resistance Co. (AW Nov. 2, p. 79); the RCA-Army Signal Corps Micro Module (AW Apr. 13, 1959, p. 75), the Burroughs' Macro Module (AW Mar. 21, p. 67) and Varo molecular circuit (AW Sept. 14, p. 85). Because the semiconductor occupies only a fraction of the total volume of the entire package, engineers seeking parts density savings have previously attempted to do away with the transistor can (AW June 16, 1958, p. 243) despite the hazards of semiconductor surface contamination.

Other components, such as resistors, capacitors and inductors, as well as conductors, which do not present the same obstacles as semiconductors, are progressing to the point where they are vacuum-deposited or sputtered in many microcircuit techniques, thereby achieving sizable space economy.

Now, however, the components industry is on the verge of marketing active components, as it is currently marketing miniaturized semiconductor diodes which are to be compatible in size reduction with the latest concepts of deposited passive components.

Two basic approaches to the smaller transistor, both of which use standard semiconductors, accepted semiconductor technology, and promise to provide housing for the currently available lower power level transistor types, are evolving. These approaches are:

• **Metal-to-metal** or metal-to-glass encapsulated packages as illustrated by transistors which will be marketed later this year by companies such as Texas Instruments, Inc., Philco Corp., and Transitron Electronics Corp.

• **Surface passivated transistors** of the type displayed by Pacific Semiconductors, Inc., at the recent Institute of Radio Engineers Convention here.

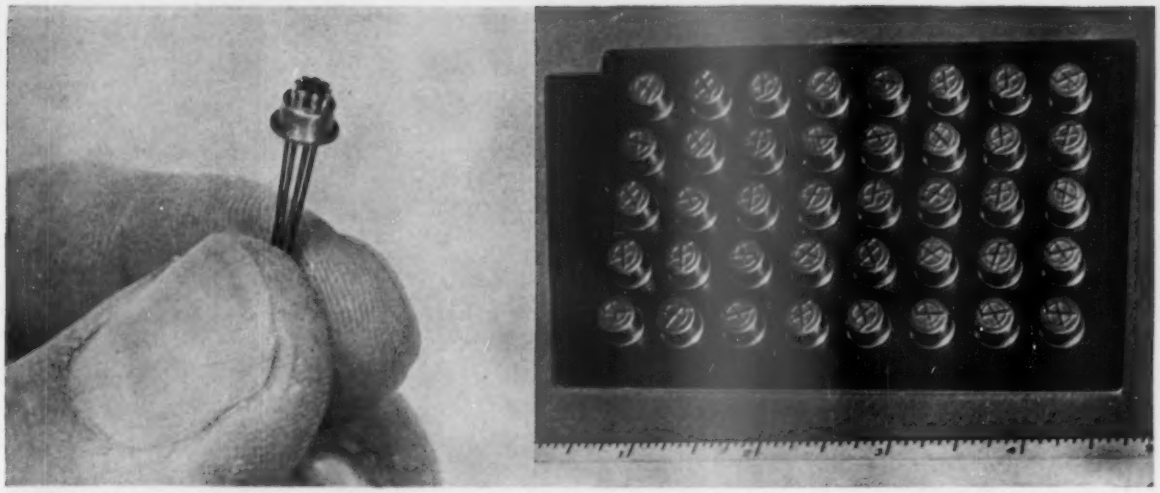
Within these two broad approaches, varying techniques, different size and shape units are being investigated. Surface passivation, a method of placing a protective surface on the semiconductor to make it passive, or stable, so that it will not react with the atmosphere, is provided by at least two specific techniques. One of these was developed at Bell Telephone Laboratories in Murray Hill, N. J. (AW Nov. 16, 1959, p. 119). Scientists there oxidize silicon to form a quartz seal over the semiconductor. The Pacific Semiconductor technique is a form of chemical treatment in which the semiconductor is made to react with an organic compound, specifically alcohol, to seal it from the outside.

There is uneasiness over surface passivated transistors in certain quarters of the industry, perhaps created by some previous difficulties with uncased transistors, and a resulting predisposition toward older encapsulating techniques.

Marketing Plans

A few of the companies developing the new microminiature transistors, and their market plans are:

• **Fairchild Semiconductor Corp.**—Mountain View, Calif., firm has a full-scale research program on microminiature transistors to be made smaller than the TO 18 package. Metal-to-metal, metal-to-glass and surface passivation approaches are being investigated. Package size and shape have not been finally determined but the firm expects that its entire line of transistors as well as new transistors developed and marketed in the next six months can be packaged in a two-dimensional form. If the mar-



MICROLOGIC ELEMENTS, which perform specific computer functions, are silicon slabs with junctions and resistors diffused onto a semiconductor base and packaged in a single can, removed (left). Elements in array (right) may be available toward end of this year and are expected to slash cost of digital computer by 70 or 80%, according to developers, Fairchild Semiconductor Corp.

This Year

ket conditions appear to warrant it, Fairchild hopes to bring the new transistors out by the end of the year, according to a company spokesman.

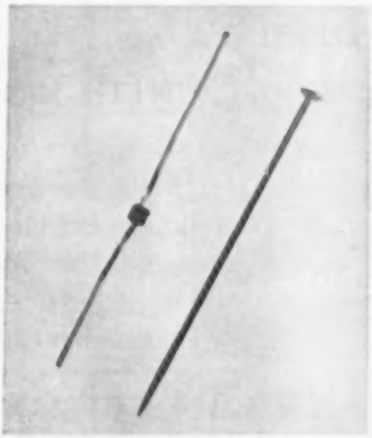
• **Pacific Semiconductors**—This company, which has been making micro diodes without cans for the past year, eliminating surface carriers by surface passivation, has two types of microminiature transistors, referred to as the micro and pico transistors. The micro transistor, which has flat gold-plated ribbon leads, is a rectangular shaped package, 40 x 80 x 35 mils, while the smaller pico (25 x 25 x 15 mils) has a large gold-plated ribbon collector lead. Pico's base and emitter leads were barely visible when the unit, placed on polystyrene foam, was displayed in a glass showcase at the IRE show.

Pacific designed these transistors into free-running multivibrators which it made for the RCA-Army Micro Module and IRC's microcircuits.

• **Philco Corp.**—Company is following the metal-to-glass package approach, which it will describe at the forthcoming Electronic Components Conference in Washington. Flat package will measure 125 x 180 x less than 60 mils and will house any type of standard computer transistor. It will have small lugs at its long ends so that the package can be dropped into drilled holes in ceramic or glass substrate of a microcircuit. Three of these transistors could be placed on a single wafer of the RCA-Signal Corps Micro Module, according to Philco. By this fall, the firm will sample the industry with these devices.

• **Radio Corp. of America**—Under both Signal Corps support and to a degree with its own funds, RCA has developed micro-element transistors, smaller in size than the TO 18. The line includes a 2N404, electrically identical but physically smaller than the standard 2N404. Firm is expected to make the Micro Modules available to the avionics industry in a "do-it-yourself" form. It will sell 3/10 x 3/10 in. 12-notch wafers as well as the micro element transistors. Preliminary industry response to this idea, as expressed at a private RCA-sponsored meeting of engineers during the IRE Convention, reportedly convinced the firm to go ahead with these marketing plans.

• **Texas Instruments**—Texas company also privately sampled industry opinion about the need for microminiature encapsulated transistors prior to and during the IRE convention. A company spokesman said a line of miniature silicon mesa transistors would be marketed this year, probably by this summer, according to a second source.



MICROMINIATURE DIODE, compared with standard one-inch household straight pin, is one of a series of diodes recently introduced by Transitron Electronics Corp.

• **Transitron Electronic Corp.**—Company is in advanced development work on microminiature transistors, to be put on the market within three months. The firm now has an entire line of diffused silicon microdiodes, including fast switching, very fast switching and high conductance diodes, voltage regulators and Stabistors.

This size reduction in encapsulated transistors, and in passive components, creates whole new problems in physical and mechanical standards for the component manufacturer.

Initial steps toward solutions to these standards problems are being made by a special microminiature components standard group now forming in the Electronics Industries Assn. and first revealed in AVIATION WEEK (Mar. 28, p. 23).

This group, according to Ed Keonjian of American Bosch Arma, its chairman, will recommend physical and mechanical requirements for individual small, reliable active and passive components, as used in digitalized data processing systems.

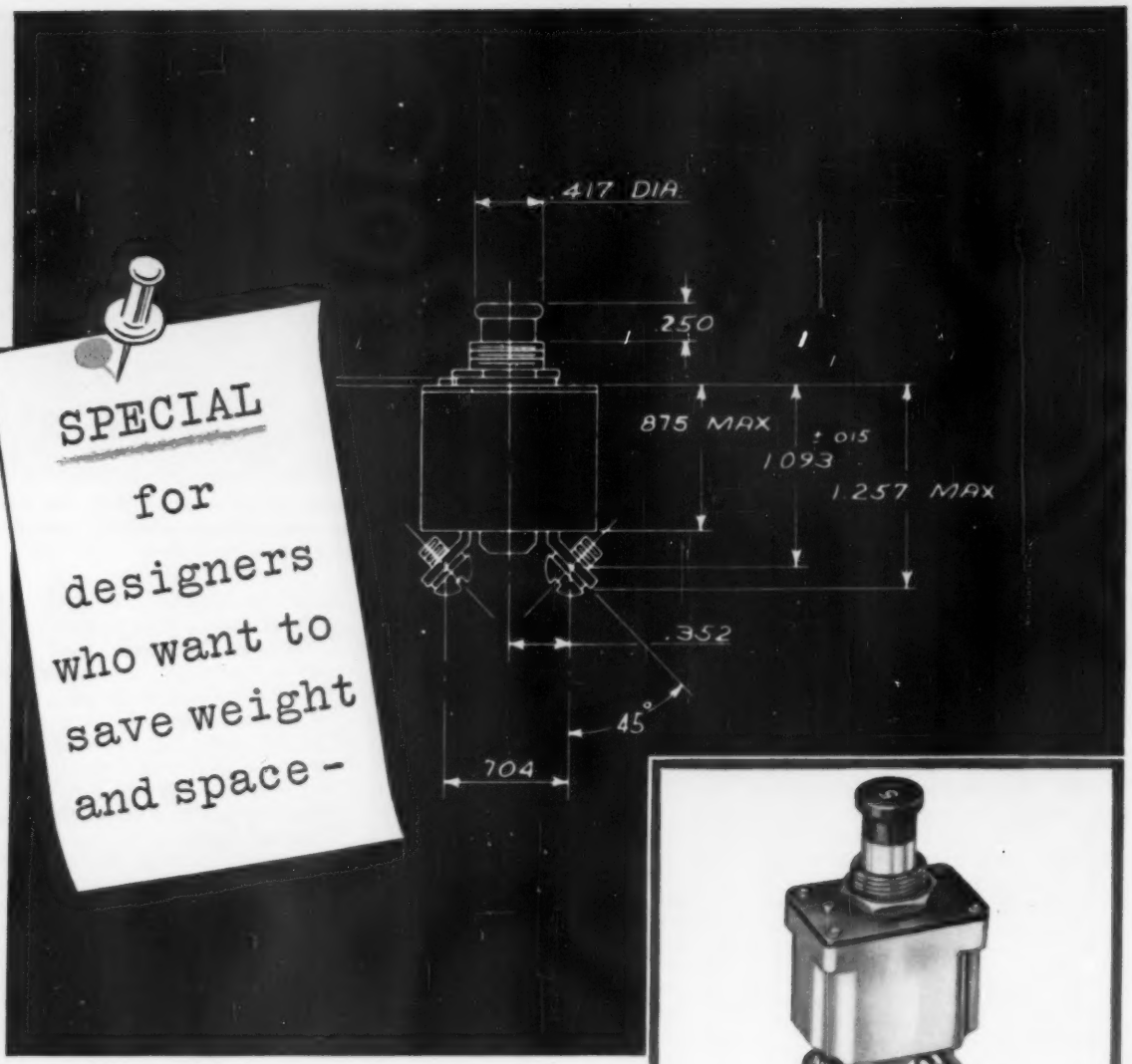
The group will make recommendations to appropriate components or semiconductor JETEC (Joint Electron Device Engineering Council) committees on:

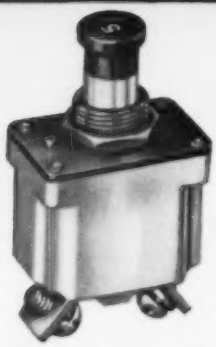
• **Form factors** and lead placement of components to facilitate production of a system.

• **Specifications** on components suitable for successful assembly of the system with particular emphasis on environmental conditions.

• **Means for handling** and transporting components from suppliers to consumers.

This latter point should not be over-





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looked, Keonjian says, because of the threat of damage in shipment of these diminutive components.

The microminiature components group, a subcommittee within the committee on computer components requirements of the EIA, will meet formally for the first time on May 2 at the Fairmont Hotel in San Francisco during the Western Joint Computer Conference. Meeting at this time gives members an opportunity to discuss various aspects of microminiaturized component specifications with systems people, Keonjian points out. In this way, Keonjian says, the component manufacturer will learn what the systems people need in microminiature components, and it will then be up to the component manufacturer to fit the form factors to the requirements.

In three earlier informal meetings, the last of which was held in Philadelphia prior to the Solid-State Circuits Conference, representatives of the following companies, which are expected to continue their participation now that the group is on a formal footing, were present: AC Sparkplug Division of General Motors, Amp, Autonetics, American Bosch Arma, Burroughs, CBS Electronics, Clevite, Corning Glass, DOFL, Hughes Aircraft, International Resistance, Philco, Litton Industries, Motorola, Pacific Semiconductors, Thompson Ramo Wooldridge, Raytheon, Sprague, Texas Instruments and Transitron.

Individuals or firms interested in the microminiature components standards group are requested to contact Keonjian directly at American Bosch Arma in Garden City, N. Y.

Not all manufacturers of microcircuits favor encapsulated microminiature components, partly because of the paucity of such devices, say the component manufacturers who are now ready to supply them. Varo Mfg., for example, a pioneer in molectronics, uses vacuum-deposited passive components with imbedded transistors. Varo, according to a representative of the firm, does not want encapsulated transistors but feels it has a good lead in surface treatment of active components which are hermetically sealed along with the entire unit.

Instead of reducing the can size of a transistor to make microminiature active components, another space-saving approach is to put more semiconductor junctions into the "wasted" space within a conventional small transistor can.

This essentially is what Fairchild Semiconductor has done with its micrologic elements.

On a single header Fairchild engineers are placing a silicon slab into which junctions and resistors are diffused to form a single circuit function, or micrologic element, rather than a single transistor. The entire assembly is then covered by one can. Individual functional cans can be mounted for interconnection on a printed circuit board.

Circuit functions in development include flip flops, half shift registers, gates, buffers and half adders. The elements are now packaged in eight-lead JEDEC TO-5 packages whose size will be sliced in half as shorter caps become available, according to Fairchild. Manufacture of these micrologic elements in eight-lead TO 18 packages is anticipated.

The nature of these elements is such, Fairchild says, that they can be produced at higher yields, have greater reliability and cost less than a high-performance transistor.

Samples of micrologic elements are not now available, but the company hopes to offer them by the end of the year. Extended life tests on individual elements are in progress.

Sperry Semiconductor has a somewhat similar functional device in its microtronic solid flip flop, which it displayed at the IRE Convention. Fairchild had initially shown one of its first micrologic elements, also a flip flop, at last year's Wescon Show.

The Sperry device measures 500 x 500 x 7 mils and a spokesman says it

Suited to most advanced concepts in space vehicle and large missile configurations

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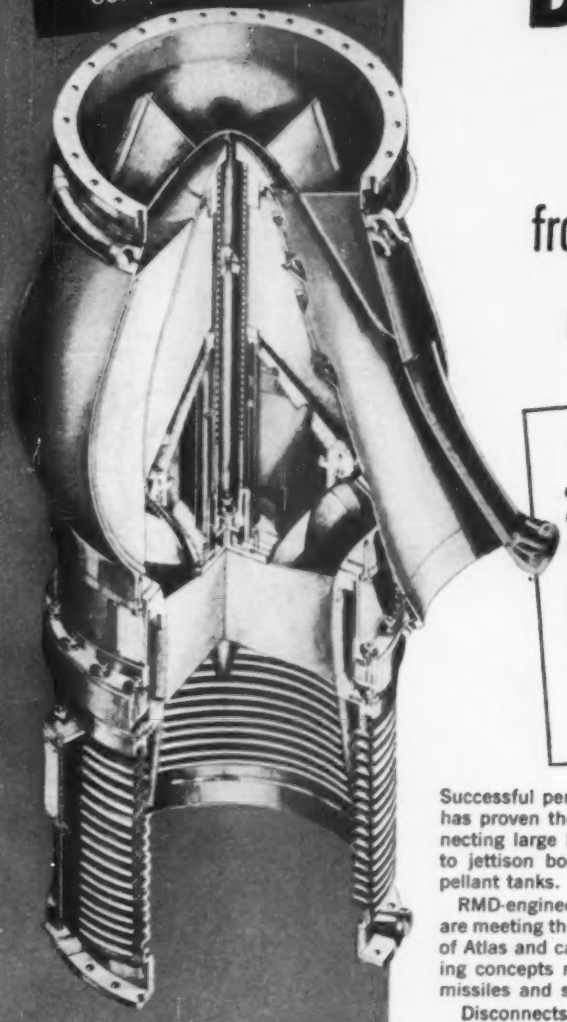
DISCONNECT VALVES

from Reaction Motors Division of *Thiokol*



Western World's Largest Flying Valve, at left:

- 11" line size
- Cryogenic Application (liquid oxygen)
- Combination disconnect—check valve—flexible duct
- Lightweight. 50 lbs. All sheet metal construction
- High flow rate—6500 GPM at 175 psi
- Minimum pressure drop—2 psi
- Missile qualified (Atlas)
- Provides for angular and axial misalignment and lateral displacement of mating ducts

Successful performance of the Atlas has proven the feasibility of disconnecting large lines in flight in order to jettison booster engines or propellant tanks.

RMD-engineered disconnect valves are meeting the operational demands of Atlas and can be adapted to staging concepts now current for global missiles and space vehicles.

Disconnects from RMD are presently available in a variety of line sizes—from 4" to 11". They're lightweight, compact and are designed to handle cryogenic, conventional, exotic and corrosive fluids and storables.

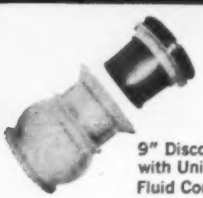
Whether your assignment involves the planning of tomorrow's missiles, or the refining of those now operational . . . look to RMD for the right propulsion system components.

For complete information, contact

Reaction Motors Division

Thiokol® CHEMICAL CORPORATION

Ford Road, Denville, New Jersey



9" Disconnect with Universal Fluid Coupling

8" Disconnect Valve

5" Disconnect (tank mounted)

4" Disconnect Valve

will be available to the industry later this year.

Another development within the semiconductor industry which is expected to further exploit the high power, high frequency potentialities of the micro alloy diffused-base transistor (MADT) is Philco's new technique of etching by transmitted light.

This etching process has enabled the company to bring a new 15-watt MADT transistor into advanced development. The transistor with a beta of 10 can switch 1 amp. in 150 nanoseconds, the company reports.

In the new process light is focused on one side of a semiconductor wafer while the etching is done by a chemical jetstream from the opposite side. As the company explains, light diffuses through the semiconductor making hole electron pairs available at the etched surface. This boosts the speed and accuracy of the etching process.

The company's earlier etching process, by which it made high frequency but lower power transistors, is illuminated from an angle on the same side as the etching process. This limited the size of flat etched pits and prevented the realization of the ultimate potential of its MADT, according to Philco.

FILTER CENTER

► **Optical Maser Patent Awarded**—Patent covering optical and infrared Masers has been granted to Drs. Charles H. Townes and Arthur L. Schawlow. Patent rights are assigned to Bell Telephone Laboratories where theoretical work on the devices was done by the two men some time ago.

► **Countermeasures Readjusts**—Countermeasures Division of Sperry Gyroscope Co. is broadening its base in electronic warfare to include such things as reconnaissance systems. Size of the division has dwindled from 2,100 to 300 people with the cancellation of Boeing B-52 electronic countermeasures contract (AW Dec. 21, p. 18). Infrared department of Thompson Ramo Wooldridge, a Sperry subcontractor on the Q-27 system, also reportedly hard hit.

► **Avien, Inc.**, Woodside, N. Y., will supply the Missile and Space Division of Lockheed Aircraft Corp. with temperature and shock monitor controller systems for use in the Polaris missile under contract of approximately $58,000. The system, applicable to solid-propellant missiles, will control shipping container temperature, will monitor and record critical shocks and temperature levels of the missile during its delivery to installation.

AMPEX AIRBORNE WIDE-BAND TAPE RECORDER, with frequency range of 10 cps. to 4 mc., making it suitable for electromagnetic reconnaissance, weighs only 150 lb. Behind tape transport is power supply. Small units at left are remote control panels.

Rotating Heads Achieve Wide-Band Recording for Airborne Recon Use

Redwood City, Calif.—Lightweight extremely wide-band magnetic tape recorder, suitable for airborne electromagnetic reconnaissance (ferret) use, has been developed here by Ampex Corp. First units recently were delivered to the Aerospace Technical Intelligence Center, Wright-Patterson AFB in Dayton.

The new AR-300 recorder is a miniaturized, transistorized version of the Ampex Videotape television recorder, but has greater frequency response than the TV program recorder.

The AR-300 weighs less than 150 lb., occupies 3½ cu. ft., and provides two wide-band recording channels capable of recording data over the frequency range of 10 cps. to four megacycles per second.

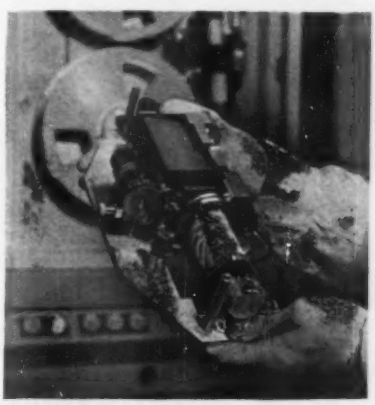
Amplitude response is flat to within 3 db. over this frequency range, the company says.

In addition to the two wide-band channels, the AR-300 recorder also provides two auxiliary recording channels with frequency response from 200 cps. to 15 kc.

To achieve extremely wide-band recording with moderate tape speeds, the new AR-300 employs rotating recording heads which Ampex pioneered for use in its Videotape recorder. Four miniature recording heads, for each wide-band data channel, are mounted around periphery of a rotating drum.

As the recording head drum rotates, the information is recorded transversely along the width of the tape, but because the tape simultaneously is moving longitudinally, the information is recorded in a stripe pattern which resembles a barber's pole. The net effect is to provide an effective speed which is far greater than the tape's actual longitudinal speed.

The new AR-300 provides a choice

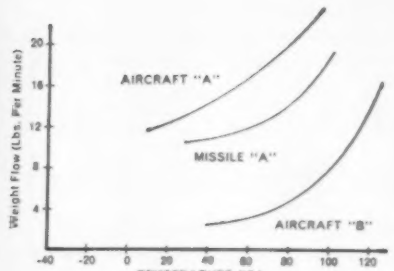


ROTATING DRUM, with four recording heads, first used in Ampex Videotape recorder, records transversely on tape, permitting wide-band recording with moderate tape speed.

VĀP-AIR cooling effect detector

Senses the actual cooling effectiveness of the air being delivered over electronic components . . . regardless of volume, density or temperature delivered.

A unique and proven device — lightweight, positive, accurate . . . under all conditions.



COOLING EFFECT DETECTOR SCHEDULES

Area of adequate cooling lies above each curve. Area of deficient cooling lies below and to right of each curve. Since the Cooling Effect Detector is adjustable, it can be matched to each curve.

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Honeywell Designs Data System for Allegany

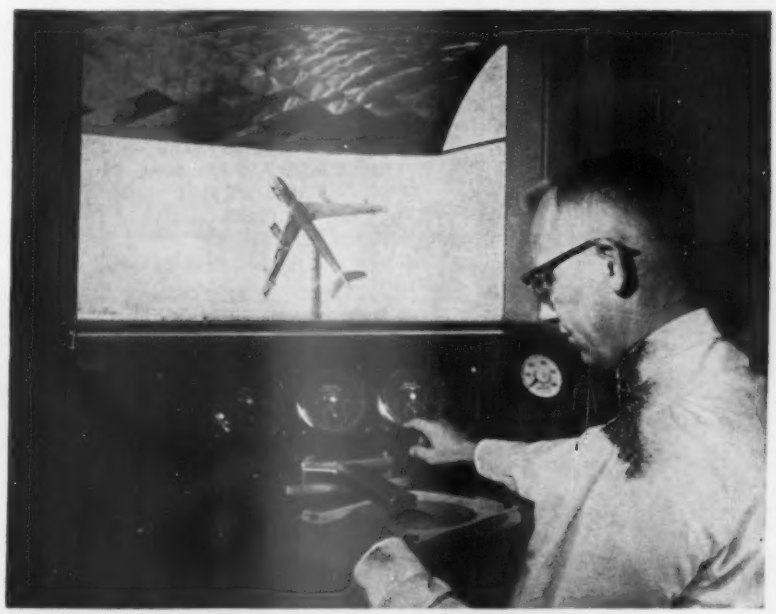
Minneapolis-Honeywell's Industrial Systems Division built this data acquisition and processing system for Navy's Allegany Ballistics Laboratory, which is operated for Navy by Hercules Powder Co. Shown are the digital data handling and analog recording and playback sections of the solid-state modular system. Unit has a sampling speed of 10,000 items per second in making 167 simultaneous measurements of temperature, pressure, force, strain, vibration, displacement and other variables in testing of solid fuel rocket motors.

of two tape speeds: 12½ and 25 in. per sec. The slower speed can be used to provide a full hour's recording of a single wide-band channel from a 10½ in. diameter reel (3,800 ft. of tape). A half hour recording time of two wide-band channels is obtainable at the higher speed. The tape used is one-mil thick Mylar base, two inches wide.

The wide-band data is recorded using frequency modulation of a 6 mc. carrier. Ampex says it uses FM to provide uniform recording from the four rotating heads (per channel) and eliminate variations which might otherwise result because of slightly different sensitivities among the four heads. Frequency modulation also effectively reduces the number of octaves that must be recorded on a single track.

In addition to the eight rotating heads for the two wide-band channels, the AR-300 provides additional heads to record narrow-band data on the auxiliary channels and for control and monitoring. To provide a visual indication that the wide-band data is being recorded, the Ampex unit records a direct-current saturation-level track along the edge of the tape just before it passes over the rotating drum. If the wide-band heads are functioning, a segment of this d.c. track will be erased each time it is crossed by a wide-band head, generating a signal to light a lamp on the control panel.

Because plastic-base tape expands and contracts with temperature changes, and such dimensional instability can not be tolerated in high accuracy transverse recording, the AR-300 internal temperature is maintained at 60C by means of external thermostatically controlled cooling air, while the tape itself is pre-heated by hot air prior to passing over the recording drum. Recorder is



Boeing Antenna Test Range

Antenna pattern range at Boeing's Wichita Division, capable of rotating 350-lb. model, is used in studies of antennas for high altitude, high Mach number conditions. System includes use of ferrites, slow wave and exponential current distribution antennas.

D SYSTEMS

PLUG-IN PUMP FOR THE CONVAIR 880

This submerged booster pump can be removed for routine inspection without draining fuel tanks. The pump is self-priming and thermal-protected for aircraft safety. It handles 35 gpm at 13 psi, with power supplied by an integral 200-volt, four-cycle ac motor. This TAPCO pump is being installed on all production models of the Convair 880 and 600 jet airliners.

TAPCO'S 1-MILLIONTH CENTRIFUGAL BOOSTER PUMP

This 28-volt dc unit, with a rating of 22 gpm at 27 psi, is the *one-millionth* TAPCO centrifugal booster pump to come off our assembly lines. These pumps have piled up outstanding performance records with Boeing, North American, Lockheed, Republic, McDonnell, Northrop, Convair, Grumman, Chance Vought, and other aircraft companies. More than 20 years of experience have made TAPCO the leading designer and manufacturer of aircraft and missile pumps to meet increasingly severe conditions of altitude, rate of climb, pressure, gravity and fuel chemistry.

WATER-INJECTION PUMP FOR THE BOEING 707

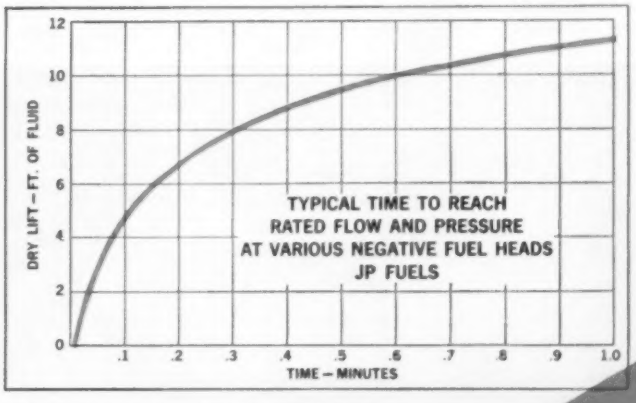
This compact water-injection pump is used on each of the four engines on Boeing's 707-120 jet stratoliners. It develops 40-80 gpm with a maximum discharge pressure of 400 psi. The regenerative pumping principle permits high pressures and high flow at a relatively low engine-pad speed. Additional developments by TAPCO after qualification and acceptance has further increased the useful service life of this pump by 500%.

Write on your company letterhead
for our Pump Data Folder

TAPCO FLU

SELF-PRIMING PUMP FOR THE NORTH AMERICAN A3J FEATURES 2-SPEED MOTOR

This is the main fuel booster pump for the North American A3J Vigilante. It was designed by TAPCO on a unique "snorkel" principle to allow proper fuel flow under all conditions . . . normal-G, negative-G, and inverted flight. Fuel intake is switched to either end of the 4-foot inlet tube by a gravity selector valve to meet flight conditions, and the rating is maintained from 80 gpm at 7 psi to 130 gpm at 25 psi. For economical operation at cruise, the 200-volt ac motor has two selected speeds. Utilizing TAPCO's efficient method of vapor-separation, this snorkel pump helps make possible the high rate-of-climb and altitude performance of this Navy attack-reconnaissance aircraft.



Graph above shows dry lift capability of TAPCO self-priming centrifugal pumps.

TRW

TAPCO GROUP

Thompson Ramo Wooldridge Inc.

DEPT. AW-460, CLEVELAND 17, OHIO

DESIGNERS AND MANUFACTURERS FOR THE AIRCRAFT, MISSILE AND SPACE, ORDNANCE, ELECTRONIC AND NUCLEAR INDUSTRIES

contained in an airtight glass fiber and metal case, with built-in shock isolators, which is pressurized to 14.7 psi.

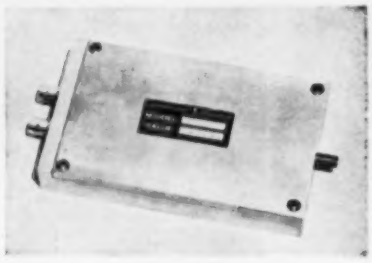
Ampex also has developed a ground-based companion unit for the AR-300, known as the FR-700, which provides both wide-band recording and reproducing functions, whereas the airborne unit provides only recording. The FR-700 uses many of the same components as the airborne unit, but is mounted in a 19-in.-wide rack that stands 72 in. high.

Development of the two new wide-band tape units was launched initially with Ampex funds, followed by Air Force contracts awarded in the summer of 1958 to accelerate the program.

NEW AVIONIC PRODUCTS

Components & Devices

• **Coaxial attenuator,** Model RDA-971, has BNC connectors and a variable range of zero to 25 db. (minimum) with less than 1 db. frequency sensitivity over range from d.c. to 1 kmc.



Rotation of ¼ in. shaft varies attenuation. Maximum insertion loss and VSWR are 0.5 db. and 1.3, respectively. Price is $280 for small lots with a four to six week delivery. Radar Design Corp., Syracuse, N. Y.

• **Airborne speaker amplifier,** CA-3C, is designed to deliver full 7.5 w. output and overcome cockpit noise under severe conditions. Amplifier weighs 18 oz., does not require a shock mount, measures 2¼ in. wide, 5.44 in. length and 2¾ in. height, and is available in both 14 and 28 v. d.c. models. Frequency response is flat from 300 to 8,000 cps. within 3 db. points, amplitude distortion is less than 8% at maximum output and standby current drain is 80 ma. and maximum current requirements are ½ amp. for 28 v. model and 1 amp. for 14 v. model. Flite-Tronics, Inc., 3312 Burton Ave., Burbank, Calif.

• **Relays, models** BR-1S and BR-2S, have 5 mw. sensitivity, will handle up to 2 amp. at 32 v. d.c. or 110 v.a.c., withstand high g shock and vibration and will operate between –65C and 85C (BR-1S) or 125C (BR-2S). Single unit orders will be filled within three weeks at an individual unit cost of $10 each, according to firm, Babcock Relays, Inc., 1640 Monrovia Ave., Costa Mesa, Calif.

• **Silicon transistors,** Models PT 900 and PT 901, diffused, mesa units with power dissipation of 125 w. at 25C case temperature, 50 mc. alpha cutoff frequency, 10 amp. continuous collector current and 0.2 ohm saturation resistance. Initial prices are $155 and $195 for PT 900 and PT 901, respectively. Expected applications are as power con-

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Buckeye's #12101A overwing nozzle is loaded with features that make refueling safer, easier, more economical, too. 3 bumper rings keep metal parts of the nozzle away from the aircraft skin. Hose wear is held to a minimum by the built-in 360° inlet swivel. The 2-inch N.P.T. swivel turns freely on teflon and ball bearings and is accessible for repair.
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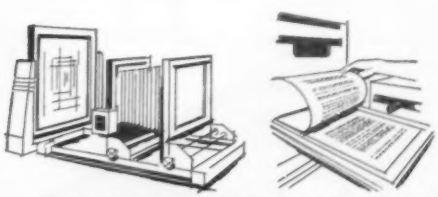

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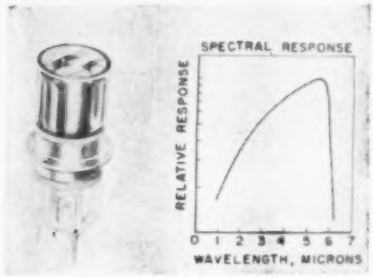
XeroX Copyflo equipment for inexpensive, high speed, volume reproduction from microfilm or original documents.

HALOID XEROX

verters and inverters which operate at frequencies up to one megacycle. Pacific Semiconductors, Inc., 10451 West Jefferson Blvd., Culver City, Calif.

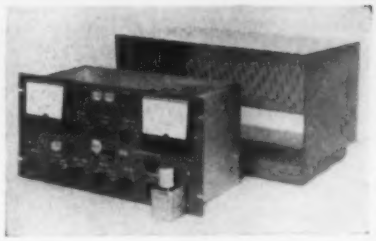
• **Infrared detector,** Model J-02, utilizes photovoltaic effect in indium antimonide at liquid nitrogen and exhibts NEP values of two micromicrowatts at five microns and seven micromicrowatts for 500K black body. Detector area is 0.1



x 0.1 mm. squared and responds from visible region to 5.7 microns with a time constant of less than one microsecond. Radiation Electronics Co., 5600 Jarvis Ave., Chicago 48, Ill.

Test Equipment

• **Relay tester,** Model RT-905, which measures pull-in and drop-out voltage and current simultaneously, is available in standard rack mount unit (8¾ in. x 19 in.) and enclosed chassis assembly 17 in. wide, 8¾ in. high, and 8 in. deep. Coil voltage on the tester is continuously variable and neon lights associated with on-off control indicate contact position. Three repetition rates for go/no-go tests are available. Unit is priced at $870 less cabinet, f.o.b. company, Electronic Engineering Co. of California, 1601 East Chestnut Ave., Santa Ana, Calif.



• **Tunnel diode curve tracer,** Type 9129, to be used in conjunction with a high gain (10 mv./cm.) laboratory oscilloscope, presents current-voltage characteristic of tunnel diodes throughout their negative resistance regions. The tracer has a clip for receiving two types of tunnel diode packages now available. In a typical test, vertical, horizontal and ground terminals of the scope are connected to corresponding receptacles on a tracer box, the diode is clipped into a knob on the tracer, and a four-position range switch is adjusted to proper impedance level. Accuracy of conversion (ratio of current to voltage) is ±1% provided the scope is properly adjusted. Tracer is packaged in an epoxy container and is operated from a standard 115 v. source. Units cost $47.50 each from Trak Electronics Co., 48 Danbury Rd., Wilton, Conn.

TV Parking System Evaluated at London

Closed circuit television for ground traffic control at London Airport is under evaluation in a special control center established in the arrivals and departures building. System was installed to cope with the airport's increasing parking problems.

Mars

Because its reddish glow may have suggested blood and violence to the ancients, Mars was named for the God of War. Of all the planets it is the only one we can readily observe. Mercury is too near the sun and heavy clouds veil the surfaces of the rest.

About once every two years you may see a bright star rising in the heavens as the sun sets. The ancients named Mars for the God of War, perhaps because to them its ruddy color suggested blood.

Of all the planets, we know Mars best. We see it most clearly. We study it most closely. Yet, Mars has always been a mystery to man. And so it is today.

Of course, we know something

Changing Concepts of the Cosmos

Reproduction of one of the finest, current drawings of Mars, showing the visible markings of the planet, and a yellow dust storm sweeping across its surface. The original is by Dr. de Vaucouleurs of Harvard College Observatory.

about Mars. It rotates on its axis with a day of 24 hours, 37 minutes. It has changing seasons, and a diameter about half that of the earth.

Through a large telescope Mars looks reddish-yellow with patches of grey or grey-green. What are these patches? Oceans, said early astronomers. Vegetation, we believe today.

We can see the polar caps of Mars most likely thin layers of frozen water, for they vanish in summer and return in winter.

On Mars, you would find the atmosphere thin and probably composed of carbon dioxide and water vapor. There would be very little water. The Martian sky would be nearly black, and dotted with high-floating blue or violet clouds of fine ice powder.

You would face storms at times. And strong winds that sweep up large clouds of yellow dust as they drift across the planet.

Some observers have said they see a complex web of fine lines on Mars. Other, equally reliable observers have seen nothing. Most astronomers now agree that these controversial "canals" may be only an optical illusion. But they are surely not artificial waterways.

Where vegetation exists—and we believe it does on Mars—animal life is possible, too, though it is not likely that human-like life will be found. But here we have no relevant observations. Only exploration of the planet—first by probes and then by manned expeditions—can answer this question in a final way.

Because we believe that cosmography—the geography of the cosmos—will play a vital role in the future, McDonnell Aircraft has instituted important basic research in astronomy, solid-state physics, chemical kinetics and mathematics.

These research programs are oriented toward a fuller understanding of the universe: That men—men of all nations—may cooperate in the exploration of space, the moon, the sun, and the planets. That, through such adventure, men may better understand themselves and one another.

McDONNELL *Aircraft* St. Louis 66, Missouri

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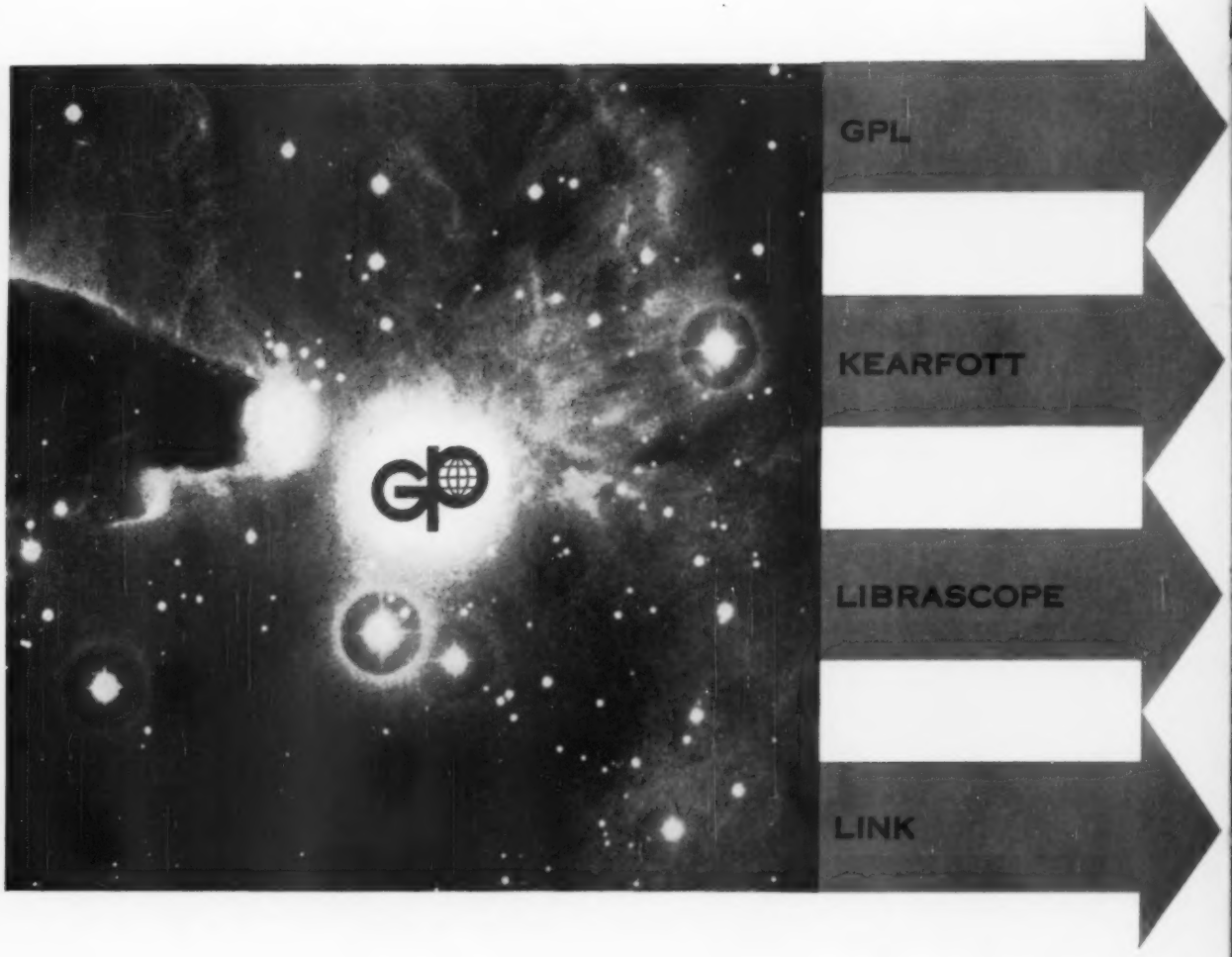

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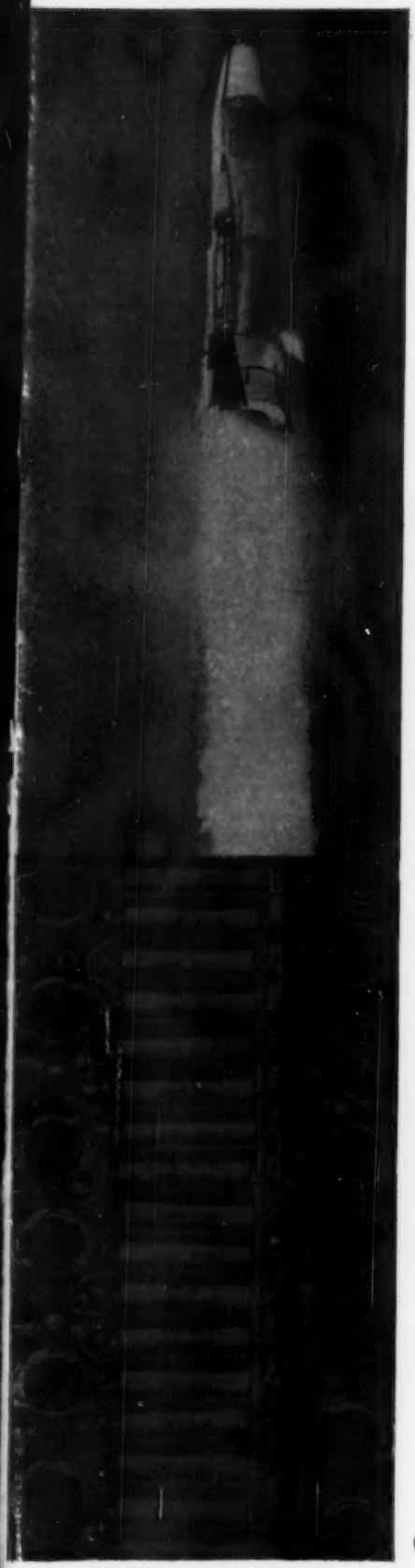

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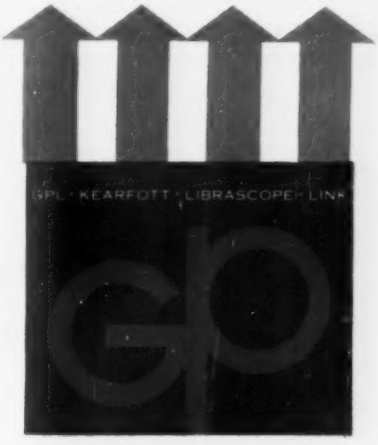
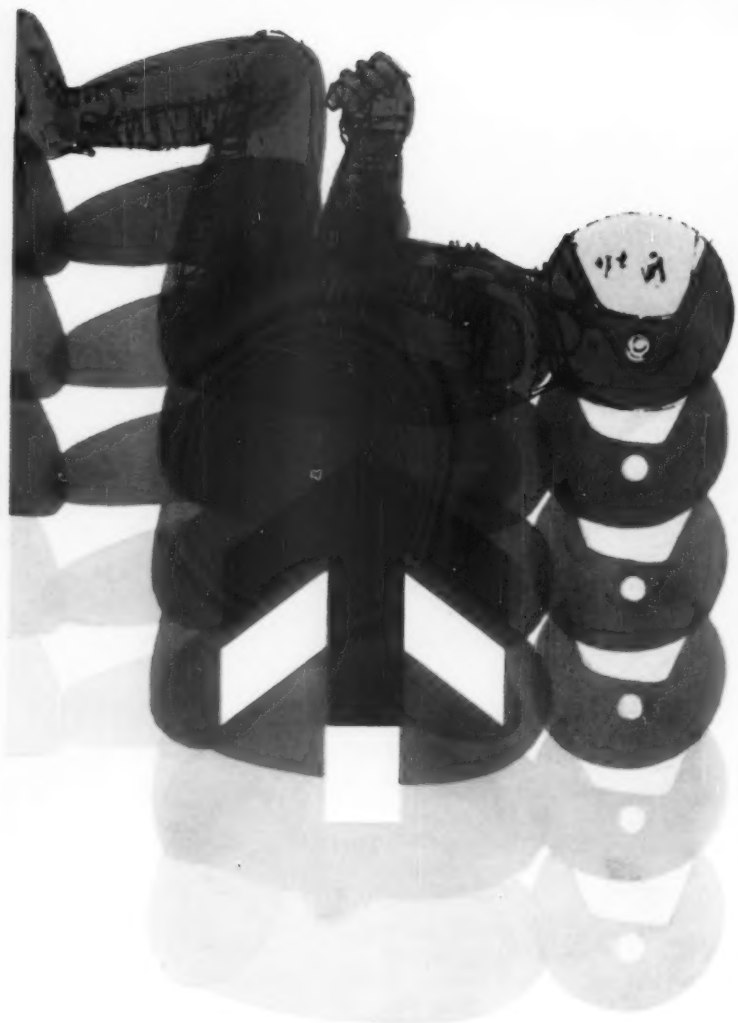


GENERAL PRECISION, INC.

MAN OUT...



A fascinating project at Martin-Denver and one which offers to the truly creative engineer or scientist a personal esteem and professional recognition unequalled in today's opportunities. Please do consider being a part of this or other creative involvements at Martin-Denver and inquire of N. M. Pagan, Director of Technical and Scientific Staffing, (Dept. CC 9), The Martin Company, P. O. Box 179, Denver 1, Colorado

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MARTIN-DESIGNED CIRCULAR SPACE COMPUTERS ARE AVAILABLE **FREE** TO INTERESTED PERSONS BY WRITING TO THE SAME ADDRESS.

Navy Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Navy contracting offices.

DEPARTMENT OF THE NAVY, BUREAU OF NAVAL WEAPONS, Washington, D. C.

North American Aviation, Inc., Columbus, Ohio, 10 weapon systems, Model A3J-1 in accordance with detail specification SD-324-1-2(S), NOas 60-0147, letter contract (FD-22-3211-0), $54,164,150.

Chance Vought Aircraft Inc., Dallas, Tex., research and development of various types of permanent tubing connections, NOas 60-6007-c(AE-61-2270-0), $99,984.

Unitec Corp., Baltimore, Md., 24 man months of field engineering services for aircraft electrical and electronic equipment, NOas 60-4088-s(MA-60-656-0), $29,576.

Reid Ray Film Industries, Inc., St. Paul, Minn., preparation of master shooting script with partial storyboard and production of four 35mm. black and white sound motion picture training films, NOas 60-4111-f(PH-5-2148-0), $39,861.

Dalmo Victor Co. Division, Textron, Inc., Belmont, Calif., 60 man months of field engineering services for aircraft electronic and electrical equipment, NOas 60-4059-s(MA-60-629-0), $79,380.

Bendix Pacific Division, Bendix Aviation Corp., N. Hollywood, Calif., 24 man months of field engineering services for aircraft electrical and electronic equipment, NOas 60-4055-s(MA-60-616-0), $31,323.

Wah Chang Corp., New York City, research and development facilities and personnel to produce pilot quantities of stock from which high quality sheet can be manufactured, NOas 60-6046-c(AE-41-4729-2), $255,791.

Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y., studies pertaining to automating the information extraction of military serial reconnaissance systems, NOas 60-6059-c(PH-46-2079-0), $49,941.

Chandler Evans Corp., West Hartford, Conn., 16 man months of field engineering services for carburetors and fuel control equipments, NOas 60-4024-s(MA-60-582-0), $25,915.

General Electric Co., West Lynn, Mass., amplifiers, controllers and directional gyro in accordance with specification MIL-C-17855A(AER), NOas 60-0156-f(PD-42-2285-9), $1,279,270.

Product and Industrial Engineering Corp., Arlington, Va., 60 man months of field engineering services for aircraft electrical and electronic equipment, NOas 60-4074-s(MA-60-635-0), $54,528.

General Instrument Corp., Brooklyn, N. Y., 24 man months of field engineering services for aircraft electrical and electronic equipment, NOas 60-4065-s(MA-60-626-0), $32,432.

Defense Electronic Products, Radio Corp. of America, Moorestown, N. J., seven AN/FPS-16 radar sets and four boresight towers and ancillary equipment in accordance with Bureau of Aeronautics specifications XEL-303, NOas 59-8076-f(AV-43-3003-9), $6,397,137.

International Electronics Manufacturing Co., Annapolis, Md., 60 man months of field engineering services for aircraft electrical and electronic equipment, NOas 60-6068-s (MA-60-629-0), $68,897.

Cook Research Laboratories Division, Cook Electric Co., Morton Grove, Ill., research and development facilities and personnel to reduce the vulnerability of countermeasures of airborne weapon systems, NOas 60-6055-c(AV-32-1543-0), $124,830.

Pioneer Central Division, Bendix Aviation Corp., Davenport, Iowa, 26 man months of field engineering services for liquid oxygen equipment, NOas 60-4019-s(MA-60-584-0), $44,626.

American Film Producers, New York City, preparation of master shooting scripts with partial storyboards and production of four confidential 35mm. training films in accordance with Joint Army-Navy specification JAN-P-55 and amendment No. 1 thereto, NOas 60-4112-f(PH-5-2154-0), $39,219.

AVIATION SUPPLY OFFICE, 700 Robbins Avenue, Philadelphia, Pa.

Del Mar Engineering Laboratories, Inc., Los Angeles, Calif., services and materials to repair, overhaul, modify and place in operating condition, Del Mar Radop target training systems, N383-61524A(383/22691/60 and 383/226042/60), $159,018.

Gentex Corp., Carbondale, Pa., helmets, flying, pilot's protective, one piece, with integrated visor, N383-62838A(IFB-383-321-60), $323,455.

Industrial Products Division, International Latex Corp., Dover, Del., life rafts with carrying cases and survival kits, inflatable, one man, for aircraft use, N383-62826A(IFB-383-330-60), $213,557.

The Lewis Engineering Co., Naugatuck, Conn., indicators, temperature thermotype for various aircraft, N383-62062A(IFB-383-341-60), $27,014.

Switlik Parachute Co., Trenton, N. J., life preservers, vest, pneumatic, N383-62835A(IFB-383-373-60), $135,149.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., nozzles, to support turbines for F4D-1 aircraft, N383-62885A(383/212233/60), $106,613.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., kits, for modification of pitch lock assembly, applicable to C-121C propeller assembly, N383 (MIS)-62888A(MIPR 09-603-0-1610-100), $260,591.

Sundstrand Aviation Division, Sundstrand Corp., Rockford, Ill., junction boxes, used on constant speed drive equipment on P5M-1 and -2 aircraft, N383-62446A(383/234826/60), $34,299.

B. & H. Instrument Co., Inc., Fort Worth, Tex., parts kits, potentiometer, to support jet calibration testers, N383-62891A(383/262154/60), $55,333.

Blythe Aircraft Corp., Alhambra, Calif., buoys, for use in mooring seaplanes and amphibious aircraft, N383-6294A(383/244072/60), $84,759.

Air-Craft Manufacturing Corp., Avoca, Pa., tension bars, used in launching carrier-based aircraft, N383-62032A(JD-IFB-383-106-60), $197,124.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., switches, oil pressure for A4D-2 and -2N aircraft, N383-62336A(383/216275/60), $28,145.

Master Specialties Co., Los Angeles, Calif., cable and clip assemblies, aiming for automatic parachute opener, N383-62389A(383/271139/60), $46,099.

Chandler-Evans Corp., West Hartford, Conn., seal assemblies, used on pumps for various aircraft fuel systems, N383-61727A (383/[illegible]/60), $26,525.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Thomas A. Edison Industries, McGraw-Edison Co., West Orange, N. J., 23 ea., transmitters, pressure, oil, type MH-4, Aerno 61-2487; 141 ea., transmitters, aircraft, pressure, variable resistance type, type MH-3, Aerno 61-2475 and data, (PR's 00-9-05D-3072 and SB-9-01D-C133-1493), $30,012.

Technical Products Division, Waste King Corp., Los Angeles, Calif., 585 ea., type MA-1 supersonic pitot tubes, Aerno 60-9001 for airborne aircraft accessories in B-58A and F-104 aircraft, (PR's MA-9-6610-1112 and EA-0-6610-6027 and amendment No. 1), $151,456.

Courier Products Division, Model Engineering & Manufacturing, Inc., Boyne City, Mich., 1,000 ea., indicators, hydraulic, pressure, synchro style, type MS28010-5, FSN-6685-557-0215, Aerno 61-1456 for use on B-52, KC-97 and B-57 aircraft, IFB 33-600-60-70 (PR MA-9-05G-1326), $31,950.

B. F. Goodrich Aviation Products Division, The B. F. Goodrich Co., Akron, Ohio, 116 ea., wheel assemblies, main, 20 x 4.4, type VII, FSN, 1630-540-9096, Aerno 41-1197, 138 ea., brake assemblies (for 20 x 4.4 wheel, main), Type VII, FSN, 1630-555-7523, Aerno 41-1198 and data, (PR's EA-8-1630-6026 and ES-0-1630-6212 and amendment No. 1, $72,283.

The new Cherry "9000"* Series MS type rivets are now a part of our standard product line, along with our familiar knob stem rivets.

Cherry is again FIRST to provide grip markings on the rivet head—for easy identification in bins or work boxes, plus positive visual inspection after installation.

Fully approved under MIL-R-7885A, the new Cherry "9000" Series rivets are available in your choice of metals, and are installed with existing serrated stem pulling heads.

For those who prefer serrated stem type blind aircraft rivets, the Cherry "9000" Series completes the line which includes the new Cherrylock "2000" Series Mechanically Locked Stem with flush fracture, the Cherry High Clinch Series rivets—"600", "700", "800"—and the Cherry Standard MS line of knob stem rivets—the "100" and "500" Series. For information write: Cherry Rivet Division, Townsend Company, Box 2157-N, Santa Ana, Calif.

*Patent pending

CHERRY RIVET DIVISION

SANTA ANA, CALIFORNIA

Townsend Company

ESTABLISHED 1816 • BEAVER FALLS, PA.

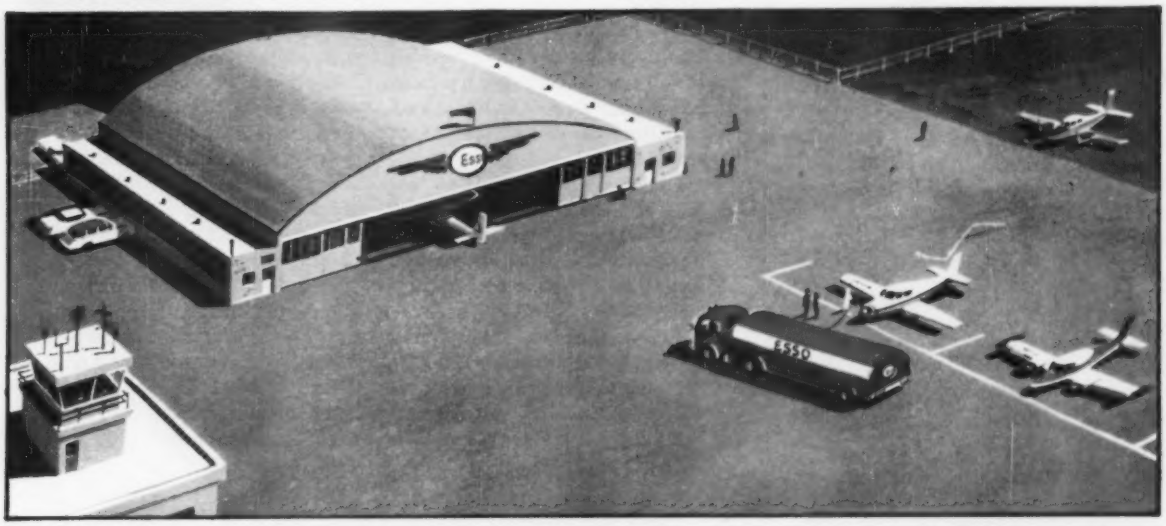
In Canada: Parmenter & Bulloch Manufacturing Company, Ltd., Gananoque, Ontario

ESSO

WING TIPS

WATCH THE BIRDIE. Whenever your plane is "staked out," even for a day or two, check your engine before take-off. Birds have a tendency to build nests in sheltered spots. An unnoticed nest near an engine in flight can lead to overheating or a mighty serious fire hazard.

DON'T BE AN EAGER AVIATOR. Don't rush to get "upstairs" with the sudden clearing of bad weather. Avoid taking foolish chances. Too many pilots have found themselves in an IFR situation with little or no instrument experience.



A GOOD SIGN. The Esso sign stands for pioneering and leadership in the development of new and improved aviation products. It stands for dependable aviation dealers serving the kind of fuel that helps assure outstanding performance. Esso Aviation Gasoline has low lead content to keep harmful deposits and spark plug fouling to a minimum, thus decreasing wear on vital engine parts. For safety, service, quality products...look first to the Esso sign.

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Highways or Skyways..."ESSO RESEARCH works wonders with oil"

USAF Leases Nuclear Blast Alarm Net

By Barry Tully

New York—First phase of an Air Force nationwide nuclear explosion alarm system will become operational upon installation of a map display board in the Washington, D. C., area.

When completed, the system will monitor over 100 possible missile targets. The Phase I system handles only East Coast areas. Reports of a nuclear blast will be simultaneously transmitted to Strategic Air Command headquarters, Nebraska; Air Defense Command headquarters, Colorado and to several Washington, D. C. area locations. Developed and installed by the Western Union Telegraph Co., the system will be leased by the Air Force at a $2 million annual cost.

The purpose of the nuclear bomb alarm system is not similar to the Ballistic Missile Early Warning System, Project Tepee (backscatter radar detection of missile launches) or other warning systems which will provide up to 15 min. notice of impending missile attack. The alarm system will provide immediate notice of a nuclear attack which may have evaded the radar nets, such as a submarine-launched missile. Additionally, the system would provide military commanders with a scoreboard of cities and military installations under nuclear attack, which would be vital in directing retaliatory measures.

The detection devices will provide positive identification of a nuclear explosion and will transmit this information even if destroyed by the blast. The detector, triggered by thermal radiation, will normally have sufficient time—one second—to transmit the alarm signal prior to the arrival of the slower moving destructive shock wave. Dispersal of three detectors about a possible target area ensures alarm signals from two detectors in the event one suffers a direct hit.

The detector unit consists of shielded silicon photo cells within a cylindrical Fresnel-type marine lens. The device is responsive only to high energy, high speed thermal radiation of a nuclear explosion with its characteristic wave shape which distinguishes it from natural radiation. This wave, consisting of a short duration, fast rising pulse, followed by a comparatively slow rising, long duration pulse, is characteristic of all nuclear explosions. Cells have a logarithmic response, producing .2 volt for a minimum blast and .8 volt for a blast one million times brighter. Response time is a few microseconds. The signal generated by the photo cells is amplified about 20 times and put in a discriminating circuit.

WESTERN UNION technician installs nuclear explosion sensing device for alarm system.

Deployment of the detectors is in groups of three at 120 deg. intervals, several miles from the center of a possible target area. The exact distance is described as sufficient for adequate foggy weather range. A centrally located blast would be detected on all three detectors which monitor a field from 0 to 10 deg. in elevation and 0 to 360 deg. in azimuth. Connecting wires and a generating station for the three detectors are located outside the central area.

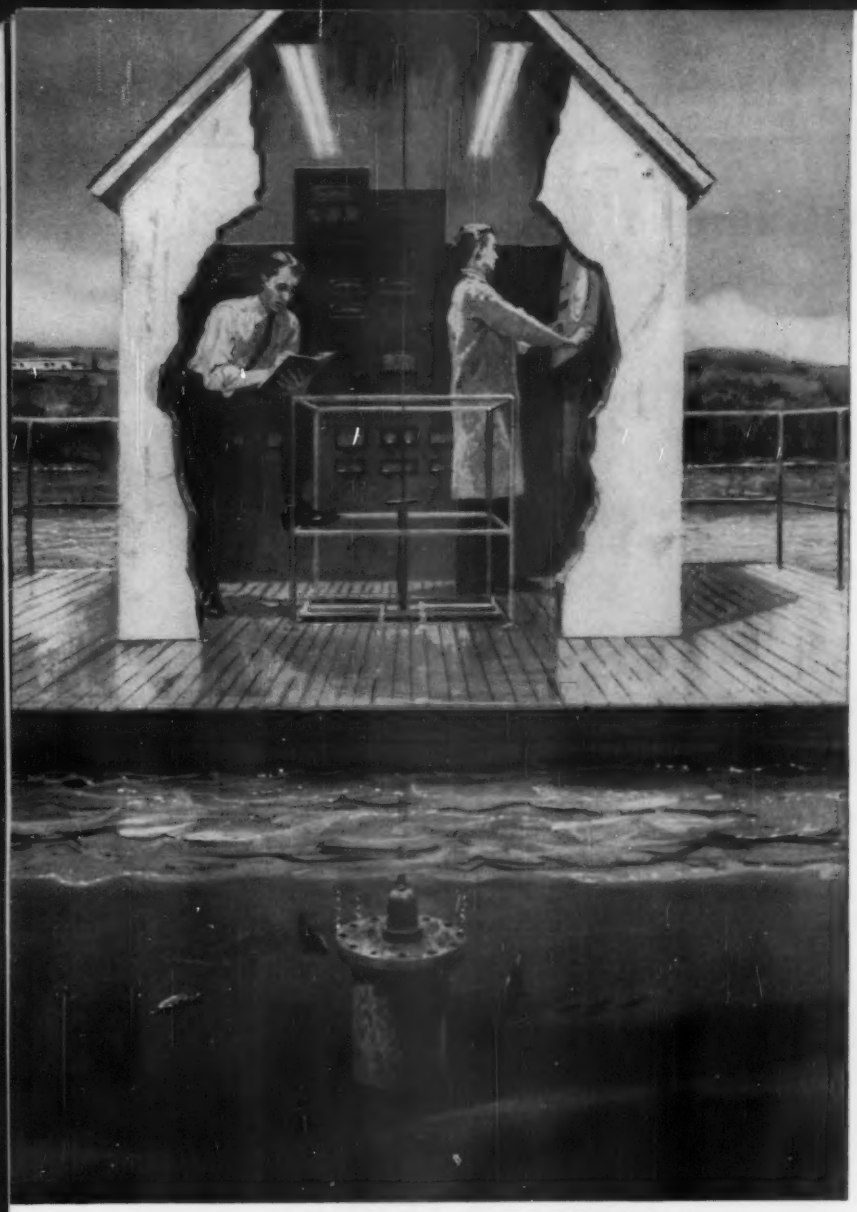
Five tests assure that the alarm signal will be given only in the event of a nuclear flash. First, the thermal energy must lie in the wavelength range between .4 and 1.1 microns. Second, the rise time of the flash must be 30 microseconds or less. Third, the amplitude must be comparable to the noonday sun. Fourth, the flash must contain a substantial amount of energy in the first peak; and fifth, the second peak must rise to a high value and contain a large amount of energy.

A built-in test flash, which can be triggered by the master control, will produce an alarm signal. This permits periodic checks to determine whether the detectors are functioning properly.

Generating stations are located some 20 mi. from the three detectors. When queried, each generating station transmits a five letter word in the standard 60-speed teleprinter code. The first three letters identify the generating station-detector combination, the fourth letter conveys status information, and the fifth is an end-of-word indicator. Three letters are used as status indicators; one for red (alarm), a second for yellow (trouble), and a third for green (equipment working and normal).

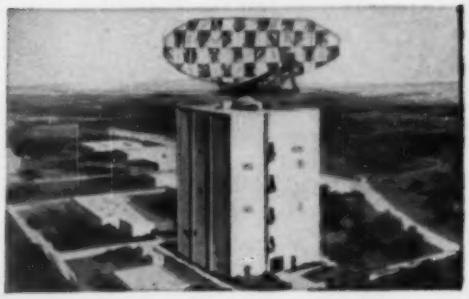
Up to 20 stations may be connected in a series loop. They will be periodically polled by a master control station under normal conditions. Upon detection of a nuclear flash, however, the generating station will transmit its alarm signal immediately. If the generating station is busy, it will wait until the end of the word being relayed—less than one second—before sending the alarm message. The alarm word, indicating a nuclear flash, would then be transmitted to the display map boards.

The prototype Phase I system includes only one master control station. The nationwide system will include three master control stations, each covering one third of the country and reporting to all map display boards.



SONAR RESEARCH SITE adjoining Sperry environmental test laboratory duplicates undersea conditions on small scale, simulates targets and myriad problems of anti-submarine warfare. Sonar search device is lowered into "depths" while engineers conduct tests in floating lab above.

PORTABLE FIELD RADAR provides Army with combat surveillance of enemy movements. Headphone signal reveals presence of moving vehicles or personnel in battle area.



TOWER OF STRENGTH in U.S. defenses is strategic network of huge radars for warning of incoming missiles and aircraft. Developed by Sperry in cooperation with the Air Force, system has 70-ton antenna, 85-foot tower.

SHIPBOARD MISSILE GUIDANCE RADARS direct Navy's Talos to target. Other Sperry systems search, track, select right missile for target, aim, fire and guide missile to target—then evaluate "kills"—all automatically.

Detecting the Unseen to Protect U. S. Defenses

Scientists develop new and sophisticated means of listening and searching, to combat the threat of new weapons

ONE OF A SERIES:

THE STORY BEHIND THE STORY
of Sperry's Surface Armament Division

The new nuclear and missile-firing submarines are swift, silent, invisible. They can cruise in the ocean depths for weeks and months, or voyage from the Pacific to the Atlantic under the polar ice cap. The difficulty of detecting them is an advantage when they're ours, and an ever-present threat to our security when they're hostile.

Such problems of detecting and guiding offensive and defensive weapons are being tackled and solved by engineers at Sperry's Surface Armament Division, working in cooperation with all the military services. Advanced techniques in sonar sound detection and torpedo fire control are being applied to anti-submarine defense projects. In addition, sophisticated and advanced radar systems for tactical search, target tracking, missile guidance, area defense and other developments help make effective such weapons as Polaris, Talos, Terrier and Nike Zeus. Sperry also provides supporting systems so important to reliability—and to keeping our defenses in readiness. Surface Armament Division, Sperry Gyroscope Company, Division of Sperry Rand Corporation, Great Neck, N. Y.

SPERRY

New Offerings

Western Airlines, Inc., Los Angeles, Calif. Offering is 200,000 shares of capital stock to be offered for subscription by holders of outstanding capital stock of record on Mar. 30, 1960; ratio of the rights offering, subscription price and underwriting terms to be supplied by amendment. Proceeds will be added to general funds, and will provide a part of the funds necessary to finance the company's flight equipment program and certain other construction and ground equipment acquisitions.

Precision Circuits, Inc., Mount Vernon, N. Y., engaged in the manufacture of precision circuit boards, supplied almost entirely to prime and subcontractors of the Department of Defense and National Aeronautics and Space Administration. Offering is $250,000 of convertible subordinated debentures, due Apr. 1, 1970, and 37,500 shares of common stock. Securities will be offered in units consisting of one $100 debenture and 15 common shares, at $150 per unit. Proceeds will be used to provide additional working capital; approximately $155,000 will be used for equipping the enlarged research and development facilities and new production facilities the company intends to establish in new quarters near its plant.

Aero Industries, Inc., Boyertown, Pa., organized in January, 1960, under Delaware law, to acquire all the outstanding stock of four companies and 80% of the stock of a fifth. The companies are Atlantic Aviation Corp., Montgomery Enterprises, Inc., Wellington Packaging Machinery, Inc., Jacobs Aircraft Engine Co., and Penn Airways, Inc. Present business activities relate principally to the manufacture of spare parts for auxiliary power units used in aircraft, and the operation of an airport and related activities.

Offering is 250,000 shares of common stock, to be offered for public sale at $3.30 per share. Proceeds will be used by the company and/or advanced to the subsidiaries for the purpose of engaging in the manufacture and distribution of gas turbine engines, leasing of aircraft and packaging machinery, and real estate development.

Applied Electronics Corp. of New Jersey, Metuchen, N. J., engaged in the design, development and production of electronic telemetry instrumentation used primarily in the government's missile and space exploration program. Offering is 200,000 shares of Class A stock to be offered for public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $45,000 is to be used for the purchase of stock of Diversified Industries Corp.; $33,000 for repayment of indebtedness owing to management officials; $150,000 for the establishment of laboratory and sales facilities in Dallas, and sales and service facilities in Los Angeles; $200,000 for research and development; the balance for working capital.

Electronic Assistance Corp., Red Bank, N. J., engaged in the design, engineering, manufacture and sale of radar altimeters, telephone equipment, test equipment and ultrasonic generators and transducers. Offering is 152,698 shares of common stock; 72,500 shares to be offered for public sale for the account of the company and the remaining shares, now outstanding, by the company president; offering price and underwriting terms to be supplied by amendment. Proceeds of the sale of additional stock by the company will be used to further equip its engineering department and office; for research and development; for advertising and promotion. The balance of approximately $594,750 will be added to working capital, and it is anticipated that $300,000 will be used to finance the purchase of materials, components and a finished goods inventory; the balance will be applied toward hiring additional personnel and meeting larger payrolls.

BALANCED WAVE TIG WELDER DELIVERS DEEP, CLEAN "X-RAY" WELDS ON SHEET METAL or PLATE

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- A bold new concept in electrical design and circuitry is introduced in the all-new Miller BWC-300MAP. One of several notable results is complete and automatic elimination of the d-c component at all welding currents . . . an essential in certain critical welding applications.
- Due to the specially designed transformer, high arc initiation voltage and unique circuit, arc-outages cannot occur.
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EXCLUSIVES! — found only in new Miller BWC-300MAP:

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The outstanding versatility of this welder, and the specifics on its various features, are detailed fully on our form #BW-3 — a copy of which will be sent to you promptly upon request.

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Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

PROFILE of new engine cowling shows its resemblance to NASA 65000-series airfoils. New design features in the first Continental-powered Commander, Model 500A, are also present in other models.

Aero Design Studies Market Expansion

By Erwin J. Bulban

Bethany, Okla.—Steps to broaden the stature of Aero Design & Engineering Corp. as a competitive factor in the aviation industry was indicated by key executives of the company and its parent firm, Rockwell-Standard Corp., during the business plane manufacturer's 9th annual international distributors meeting here.

Signs that Rockwell-Standard management and its financial resources were providing active support to Aero Design were apparent as well as Aero Design's intent to exploit these advantages to accelerate its growth potential. Viewpoints of Aero Design and Rockwell-Standard executives pointing up trends here included:

• **Indication that Aero Design** is actively studying the military market beyond "off-the-shelf" sales of its Aero Commander light transports was expressed by company President George T. Pew. One of these areas probably would be drone aircraft. He said that the company's engineering staff was currently studying a number of military-type projects.

• **Substantial financial support,** on the order of a "couple of million dollars" has already been extended to Aero Design by Rockwell-Standard for buildup of capital investment since it acquired the company in 1958, according to Rockwell-Standard executive Vice President Carl Black. Although he declined to elaborate on Aero Design's buildup, it is known to have purchased a considerable amount of production machine tools for stretch forming, milling, welding and other work. Much of this equipment is being acquired at bargain rates from other aircraft companies which have switched over to missile work and find previous tooling obsolete, although it is in first-class condition and provides advanced production capabilities for business aircraft. Pointing out that Rockwell-Standard has some $60 million of working capital, Black emphasized that the company had purchased Aero design on the basis of its growth potential and does not intend that it maintain a status quo. Indications are that further capital will be available to the subsidiary to expand worthwhile programs.

• **Aero Design has produced** some 850 Commanders in the past 10 years, and Rockell-Standard Vice President Harry Fante noted that he sees no reason why it shouldn't build at least 3,000 airplanes in the next decade. The company's production schedule currently calls for turning out an airplane every 13¼ working hours, and Fante forsaw this rate being cut in half.

• **Increase of some 30%** in dollar volume in 1960 over last year is anticipated by Aero Design Vice President-sales Tom Harris, despite the fact that the company experienced a slow-down in production in the early months of this year in tooling up for the new models. Harris expects that 1960 output of Commanders will be approximately 190 airplanes, compared with 148 last year.

Management is constantly watching the entire spectrum of business aircraft types, above and below the Commander in size. One indication of its interest is a small four-place light twin high-wing airplane patterned after the Commander, which it built as a study of the potential of this class for the company.

Designated the Model 360, the small twin, powered by two 180-hp. engines, has a top speed of 250 mph.

Analysis indicated that costs would price the airplane out of its class and so it has been turned over to the engineering department for use as a flying testbed for experimental work. Engineering has found that it can check out aerodynamic modifications for the larger Commander airplanes on a smaller, and thus more economical scale, using the Model 360 rather than the bigger airplane, until the idea proves feasible enough to study full-scale. Many of the changes in the new line, notably the completely new engine cowl system of the new Commanders, were tried out on the Model 360.

Also being studied is the turbine-class business transport, and here current feeling of the engineering department

is that Aero Design is likely to skip the turboprop and go directly to turbojet. Engineering and management is studying all available turbine engines, but feel that the powerplants have some time to go before they will meet requirements. One of the more likely looking contenders now is General Electric's CF700 aft-fan, which costs approximately $35,000.

Design Improvements

The extensive design improvements in the four new Commanders make them new airplanes, although they bear superficial resemblance to the basic design, and are indicative of the broader tasks that Aero Design's engineering department could undertake because of the financial support possible from the parent firm. Its new line represents the biggest changes in configuration made since the company introduced its pressurized Model 720 in 1955.

First of the new airplanes shown during the distributors meeting was the 500A, lowest priced in the line but containing the basic detail changes that are characteristic of all the other models. Availability schedule of the new Commanders is: Model 500A, mid-May; Model 500B, mid-June; Model 680F, mid-July and Model 560F, mid-August. The new version of the pressurized Commander, designated 720A, will go into production later this year.

Prices of basic versions of the new airplanes are: Model 500A, $72,000; Model 500F, $87,500; Model 560F, $98,500, and Model 680F, $113,500.

Major features of the new line include: slim, low-drag airfoil-shaped cowlings closely fitting the fuel-injection engines; revised main landing gear retraction system which turns the wheels 90 deg. so that they lie flat and within the contours of the underside of the nacelles; and a novel cabin interior, made up of upholstered metal strips, which can be completely "unbuttoned" in four hours and easily replaced.

In studying possibilities of improving the Commander's performance, Vice President-engineering Ted Smith and his design team considered the powerplant system as the area providing the greatest possibilities for reduction in drag. Considering that this area can be responsible for approximately 30% of an airplane's drag, they attacked the problem on the basis of utilizing airfoil practices in the engine cowling configuration. This resulted in designing the cowlings from the NASA symmetrical 65000-series airfoil section and reduced the former cross-section by some 40%, which provided a drag reduction of approximately 12%.

These benefits increased the airplane's lift/drag ratio from the former 11-12:1 to 15-16:1, markedly improving single-engine takeoff, climb and ceiling characteristics, providing notable attendant safety gains in these critical areas, while also improving basic normal performance.

According to Smith, the Model 680 experienced a buffet in certain climb attitudes. He said that the new nacelles will eliminate buffet and vibration in any attitude, because of the improved airflow over the wings due to the cowl's airfoil characteristics. Improved aerodynamics due to the cowlings have reduced stall speeds some 5-6 mph. As a result of its excellent stalling characteristics due to smoother flow, company engineers believe the Model 500A could be landed in a field 300 ft. square at full gross weight, in an emergency.

Optimum solution required a systems approach to the powerplant area; thus the entire section is completely new. To meet the envelope requirements imposed by the cowlings, Continental and Lycoming provided valuable cooperation in narrowing the silhouettes of their engines by relocating accessories, yet maintaining accessibility. Engine cowlings are approximately 9 in. less deep than on the previous models, also paying off in increased side visibility from the cockpit and passenger windows.

Another major change in this area is the deletion of the former augmentor exhaust tube system, which was responsible for considerable exterior and interior noise, and development of a completely new system on the Commander, which takes the exhaust gases upward over the top of the nacelle. Called the augmented cowl flap system, gases are exhausted and engine cooled via two electrically-operated flaps atop each nacelle. Opening is only 40% that of the former exhaust augmentor tubes and is said to provide noticeably more effective cooling.

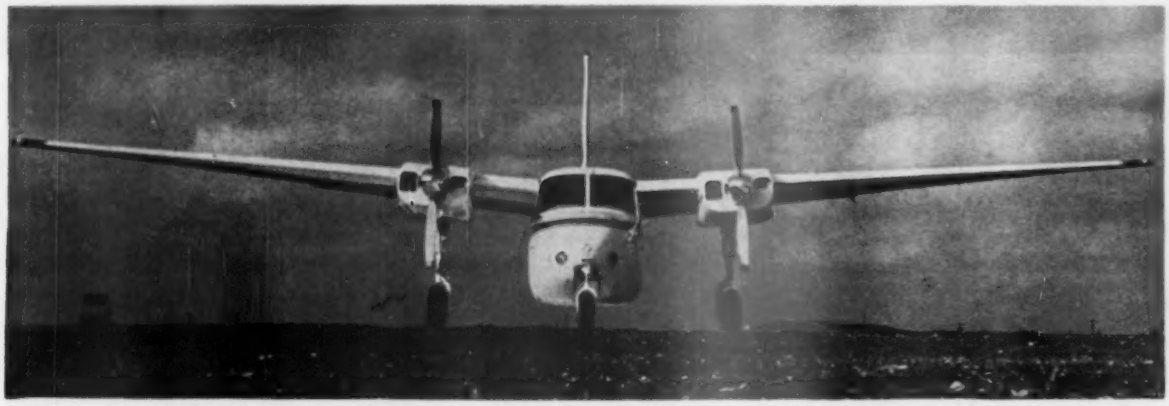
Lycoming exhaust system permits running the exhaust straight back and out; on the Continental powerplant, exhaust is angled upward and out. Further lowering noise levels is use of double-wall cowlings and the fact that the propeller thrust line is raised 4.15 in., increasing tip clearance from the fuselage. According to Ted Smith, who flew the prototype Model 500A, the airplane is quieter without soundproofing than the previous model was with it.

Engine Cowlings

Engine cowlings provide greatly increased accessibility to the engine, being hinged on the lower side, using quick release latches to expose most of the powerplant. Entire aft end of the cowling can be slid back and lowered to the ground, completely exposing the landing gear and retraction system, and providing easy access to oil, fuel and hydraulic valves and the hydraulic pack, also the electrical actuator for the cowl flaps.

Engines are now mounted on single-piece aluminum forgings, replacing former built-up mounts. Forgings are extensively used in the new airplanes; other applications include landing gear struts, trusses and drag braces, drag links and attachment fittings in landing gear and cowling. Engine air induction boxes are one-piece magnesium castings.

Retraction of the Electrol main gear and revolving the wheel is a simple mechanical cycle. The center body which



FRONTAL CROSS-SECTION of engine cowlings on new Aero Commander 500 is reduced 40%, reducing drag some 10% and increasing takeoff and single-engine performance. All models of Aero Commanders have new low-drag cowlings.

Meeting the challenge in new materials . . .

Swedlow achieves new shapes in molded chopped fabric high temperature parts

Nothing quite like this reinforced high temperature part had been produced before. But the tail cone for Bureau of Naval Weapon's Tartar missile called for walls nearly 6" high, with thicknesses ranging from .090" to more than 1". The shape was complex, the tolerances close. Strength and temperature resistance requirements were high. Working closely with Convair/Pomona, Convair Division of General Dynamics, prime contractor for Tartar, Swedlow engineers assisted in the design and producibility of this extremely critical unit. They utilized an especially formulated chopped fiberglass pre-impregnated high temperature silicone resin system. Swedlow is now successfully producing the assembly, combining superior materials knowledge with skills in press molding, controlled curing and machining to close tolerances, and secondary bonding.

Call on Swedlow next time you have a challenging materials problem. Write for new facilities report "Z," and complete technical information. **(Please Refer to Dept. 10)**

Swedlow

SWEDLOW INC./LOS ANGELES 22, CALIFORNIA/YOUNGSTOWN 9, OHIO

carries the wheel is attached to an offset link that rotates the body as the gear moves rearward. Hydraulic system uses an electric pump, eliminating the former hand pump in the cockpit. Gear incorporates positive latches for locking the main wheels in the up position.

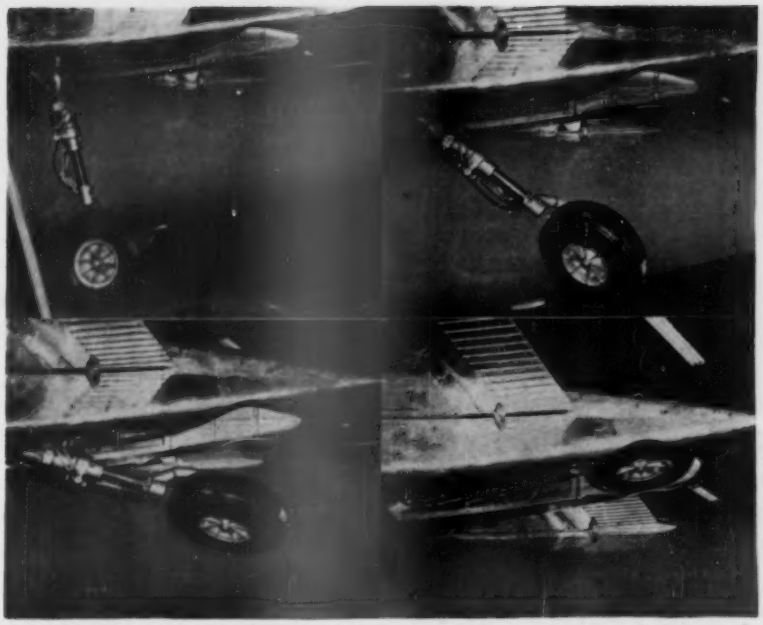
Standard Hardware

Engineers standardized hardware on many important Commander installations to ease assembly and maintenance. Interiors, instrument panels, quadrants, fuel systems, hydraulic systems can all be made on the bench and then taken out for immediate installation in the airframe. Instrument panels on all models, soft gray color instead of black for easier reading, are standardized to former Model 680E configuration. Wiring installations are also standardized.

New interior entails glueing material to long metal panels, which are then snapped into place on the fuselage structure providing a double wall which serves to deaden noise, at the same time permits unsnapping any panels necessary to quickly get at the wiring.

Other interior changes include a new air exhaust system recessed into the side of the cabin which handles adjacent areas in place of the former method of taking all air out through vents at the rear of the cabin, recessing overhead vents and reading lights into the valance panels and new, large rotating ash trays which mount flush when closed. Lighted "Fasten Seat Belts" and "No Smoking" signs flush-mounted aft of the crew compartment dividing curtain are actuated automatically from the landing-gear-down safety light switch.

Fuel injection engines are used on the entire Commander line. The Model 500A has two Continental IO-470-M engines delivering 260 hp.; the 500B has Lycoming IO-540-B1A engines, fitted with three-blade Hartzell propellers (as have the 560F and 680F to absorb higher power without decreasing propeller tip-fuselage clearance). The Model 560F is fitted with geared Lycoming IGO-540 engines of 350 hp. each and the Model 680F has geared and supercharged Lycoming IGSO-540 engines at 360 hp. each.



NEW RETRACTION SYSTEM for main landing gear on Aero Commanders turns the wheels 90 deg. so they are completely faired flat under rear of nacelle. Strut portion of gear is normally covered by doors, deleted here for clarity.

Boost Pumps

Models 500A and 500B are fitted with fuel boost pumps, integrally mounted in the fuel sump, used for engine starting and takeoff and landing. Boost pump automatically activates any time pressure drops.

Airplanes are fitted with dual 24-v. 35-amp.-hr. batteries, which replace the former single battery. New Exide batteries, built especially for the Commander series, weigh a total of approximately 28 lb., compared with some 80 lb. for the former single battery and cost is about $34, compared with $100 for the earlier installation. New Commanders also have 100-amp. generators and a new starter, both especially designed and built for them by Jack & Heintz.

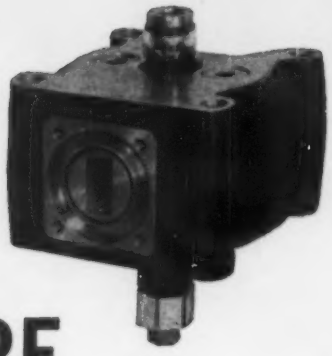
A highlight of the meeting was the

Aero Design Aero Commanders

	500A	500B	560F	680F
Maximum gross weight, lb.	6,000	6,500	7,000	8,000
Dry empty weight, lb.	4,075	4,175	4,570	4,800
Useful load, lb.	1,925	2,325	2,430	3,200
Maximum speed @ sea level, mph.	230	233	250	255[3]
Cruise speed @ 70% power @ 10,000 ft., mph.	220	222	234	244
Stall speed, gear and flaps down, mph.	61	63	66	71
Range, mi.	1,420[1]	1,250[1]	1,500[2]	1,400[2]
Fuel capacity, gal.	156	156	223	223
Service ceiling, 2-engine, ft.	23,500	21,800	21,900	28,500
Service ceiling 1-engine, ft.	10,100	8,750	10,300	16,100
Initial rate of climb, 2-engine, sea level, fpm.	1,570	1,990	1,750	1,660
Initial rate of climb, 1-engine, sea level, fpm.	430	418	520	400
Takeoff distance over 50 ft. (short field), ft.	1,200	1,300	1,070	1,380
Landing distance over 50 ft. (short field), ft.	1,130	1,155	1,210	1,320

Note: Models 500A and 500B speeds guaranteed within plus or minus 2%; climbs, ranges and altitudes within plus or minus 8%. Specifications and performance data on Models 560F and 680F are preliminary data. [1] Range at 45% power, 30-min. fuel reserve, at 10,000 ft., normal fuel, 181 mph. True Air Speed. [2] At 55% power, 30-min. fuel reserve. [3] Maximum speed at 15,500 ft. is 290 mph.

TOUGH, TINY, TUNABLE TUBES MADE HERE



KU-BAND TUNABLE TUBES are the newest in a remarkable family of Litton Industries miniature pulse magnetrons. (There are more than 60 types of Litton miniature magnetrons. Production types!) The Ku-band tubes have power ratings up to 3 kw., minimum. Except for waveguide output, of course, they are mechanically interchangeable with companion X-band tubes available at power levels up to 4 kw., minimum.

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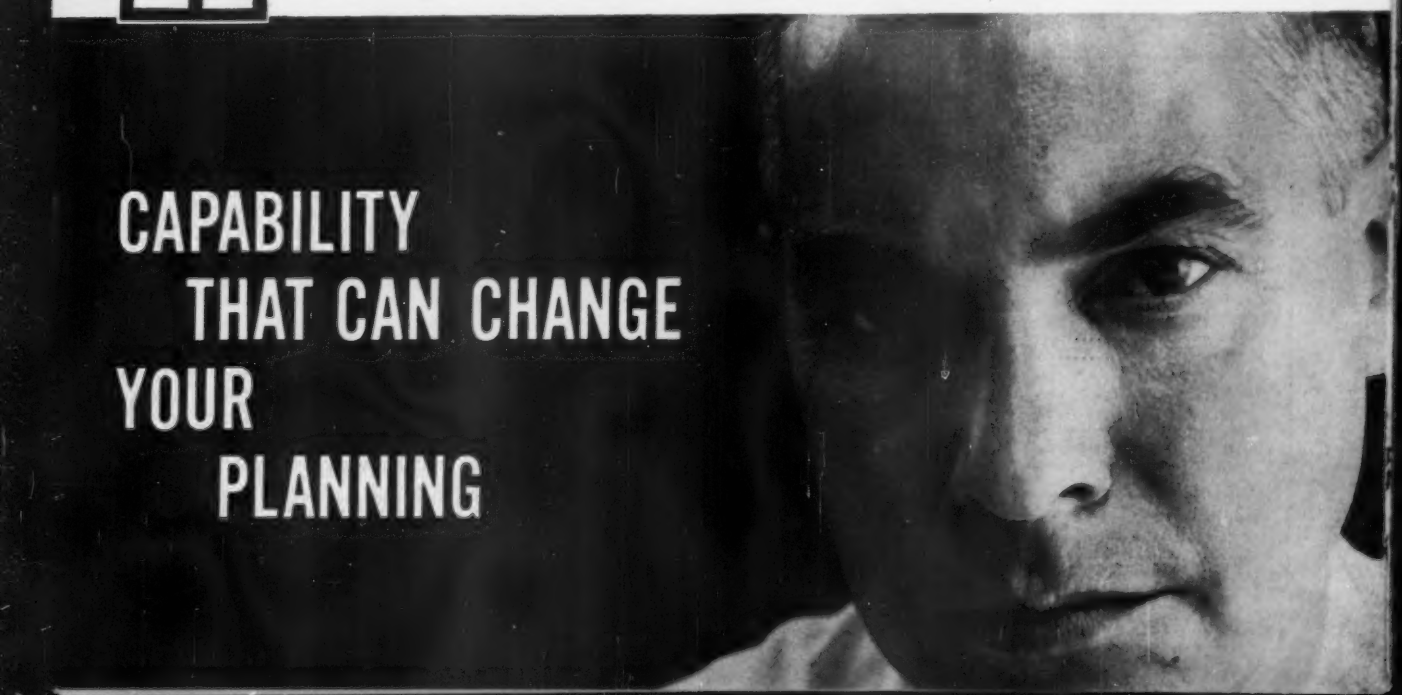
DIRECT-WRITING CRT • COLOR CRT • STORAGE TUBES • MICROWAVE FILTERS • DUPLEXERS • TR TUBES



novel "auction" system of allocating first deliveries to distributors. Due to production limitations incurred by the switchover to the new models which required extensive retooling, not enough of each model could be made available to satisfy initial distributor requirements. Also, some export distributors face regulations precluding ordering and buying aircraft on speculation with customer commitment.

Dealers Bid

To provide each distributor with aircraft in relation to his relative past year's volume and at the same time permit him to exercise judgment on the models he wanted at specified delivery dates, the first 15 delivery positions on each model were allocated to distributors based on bidding for delivery positions wanted.

This was done by issuing "play money" in various denominations to the distributors, with dollar amounts equivalent to the amount of their business volume during 1959 and 1960 to date of the meeting. Santa Monica Aviation, for example, started with an amount of "play money" that gave it bidding value roughly twice that of the next two highest distributors and roughly equal to that of the eight lowest distributors.

PRIVATE LINES

Republic Aviation has taken delivery of a Convair 240 executive transport, purchased from Frederick B. Ayer & Associates and modified by the Garrett Corp.'s AiResearch Aviation Service Division.

Private pilots' safety course has been opened by the State of New York's Commerce Department, with ground schools emphasizing courses ranging from navigation and meteorology to civil air regulations. Courses are free and are directed by Roland K. Alexander, air safety consultant in the department's Bureau of Aviation.

Hercules Powder Co., Wilmington, Del., has purchased a four-engine Lockheed JetStar (AW Mar. 21, p. 33) from Lockheed Aircraft's Marietta, Ga., Division for executive use. Plane will be used for trips to company installations at Lake Charles, La., Salt Lake City, Utah, and the West Coast. Powerplants are four Pratt & Whitney JT-12 turbojets.

Lake Aircraft, Inc., builders of the amphibious Skimmer, for which license rights were obtained from Colonial Aircraft Corp. (AW Nov. 2, p. 118), has opened production facilities in a former fabric milling plant at Sanford, Me. John F. Stayer, Lake Aircraft president, said the company has purchased a hangar at Sanford Airport. First flight of a Lake-built Skimmer will be made shortly.

U. S. women pilots will compete Apr. 29 at Miami, Fla., in the 10th Annual All Woman's International Air Race. Event is sponsored by the Florida Chapter of 99, women's pilot organization, and the Republic of El Salvador, where the 2,600 mi. race will terminate. The race is open to women holding an FAA private license and having at least 50 hr. of cross-country time and 10 hr. in the plane used for the event.

Flight tests of new RHJ-6 high-performance sailplane, designed for glide ratios in the 40s, have been started by designer-builder and national soaring champion Richard H. Johnson at Grand Prairie, Tex. RHJ-6, which spans 58 ft., has a new airfoil, especially designed for good laminar flow behavior and high lift coefficients by Dr. Eppler, of Stuttgart, Germany.

First retail customer for the Beech Queen Air twin engine executive transport is Rochling Iron & Steel Co., of Volklingen, Germany. Ohio Aviation Co., Vandalia, is first domestic distributor to take delivery of a Queen Air.

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East Germans Rebuild Aviation Industry

By David A. Anderton

Leipzig—East Germany's small aircraft industry is working toward technical independence from Russia and is driving to establish solid export markets for its widening range of products.

Industry technicians and management are rebuilding the laboratories and institutes to carry the future research and development load, instead of depending on Communist help for everything from wind tunnel time through raw materials to flight-test instrumentation.

Sales teams of Technocommerz, East German export organization charged with handling aircraft trade, have visited many of the world's "airline" countries, armed with brochures of the Type 152 transport (AW Mar. 21, p. 76). And though they are reserved about specific data, they would like it known that there is a small twin-jet transport, the Type 155, coming up, and perhaps either a helicopter or trainer powered by a Pirna 017 gas turbine (AW Apr. 4, p. 95).

These developments are all on the credit side. But among the debits are the rigid framework imposed on the country's industry by its membership in the Communist bloc, the continuous trickle of technicians and engineers who flee westward, and the tremendous need for workers of all types all over East Germany which imposes limits on the numbers of workers available for the aircraft industry.

Some Western observers believe that the industry will continue to shrink to the point where it will have to be closed down entirely for lack of native technicians. But the value of the East German aircraft industry as an instrument of national policy and propaganda is so high that the majority of Western observers believe that somehow workers and work will be found. They point out that when the industry had absolutely nothing to start with, the Russians supplied everything necessary including drawings for a license-built airplane and its powerplant. This could happen again.

Past performance of the industry is impressive considering its brief history. Engineers built about 100 twin-engine Russian-designed Ilyushin 14P transports and exported many of them to Bulgaria, China, Rumania, Hungary and North Vietnam. With them went German-built Asch 82T piston engines, increased in both power and time-between-overhaul from the original Russian production. Their sailplanes have been exported to Denmark, Finland, Syria and Russia and are going through certification checks in Holland.

Present project—the Type 152 58-seat transport powered by four Pirna 014 turbojets—is the industry's pride. It is entering production, perhaps a dozen are on the final line with two near flight test, and the engines developed for the plane have passed the East German type test and have been cleared for flight.

Development of three small gas turbines for industrial and aircraft use is well along. Three sailplanes are being built in small production quantities. Instrumentation, communications and navigation sets, ground support equipment and airport material have been designed and are being built.

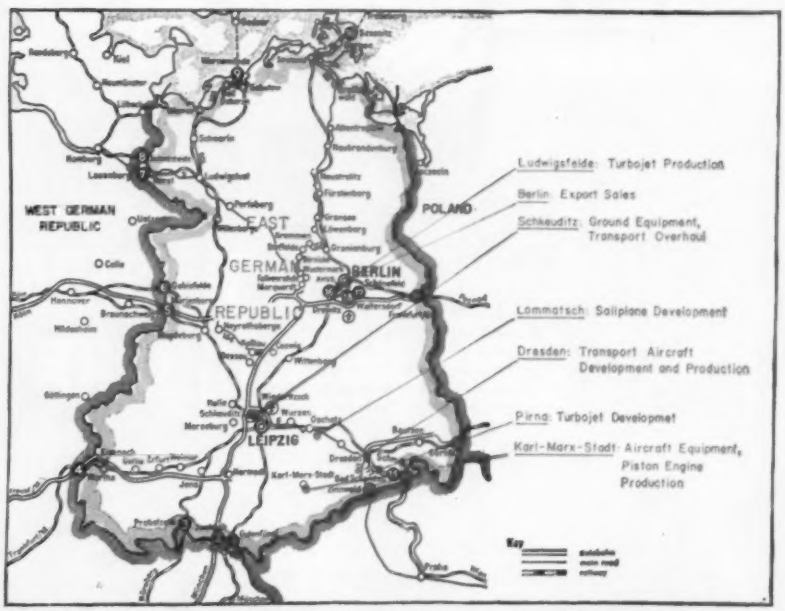
For the future there are reports of a Type 155, a 30-seat twin-jet transport layout, and of a trainer or helicopter powered by one of the small gas turbines.

Six manufacturing companies, one export organization and a group of research and supporting institutes make up the East German aircraft industry. In addition, other manufacturing or scientific organizations whose products bear on airplane construction also contribute to the over-all structure of the industry.

Administrative organization for the aircraft industry is called the Vereinegung Volkseigener Betriede Flugzeugbau (VVB Flugzeugbau), which can be translated roughly as the United People's-Owned Organization for Aircraft Construction. Each individual factory is designated with the initials VEB, for Volkseigene Betriebe (which means People's-Owned Organization), and a place name for geographic location.

These manufacturing companies comprise the bulk of the industry:

- **VEB Flugzeugwerke Dresden,** responsible for the development and production of transport airplanes. Current production is the Type 152 transport.
- **VEB Entwicklungsbau Pirna,** responsible for development of turbojets and small gas turbines for aircraft and industrial uses. Current projects include the Pirna 014 engines for the Type 152, and three small gas turbines of the Pirna 017 type.
- **VEB Industriewerke Ludwigsfelde,** responsible for the production of turbojets and small marine engines. Pirna 014 is being built here.
- **VEB Industriewerke Karl-Marx-Stadt,** responsible for the development and production of equipment for transport



LOCATIONS of East German aircraft industry factories are shown. Six manufacturers, one export organization and research and supporting institutes comprise the industry.

aircraft and for the production and overhaul of piston engines. Current projects include building the Russian-designed Asch 82T piston engine under license.

• **VEB Maschinen-und Apparatebau Schkeuditz,** responsible for development and production of ground equipment for transports and airports, as well as overhaul of transport aircraft. Current work probably includes overhaul on the fleet of East German Deutsche Lufthansa.

• **VEB Apparatebau Lommatzsch,** responsible for the development and production of gliders and sailplanes. Present work load includes the "Lehrmeister" and "Libelle" sailplanes.

Export contacts and the sales for the entire aircraft industry are made by Technocommerz GmbH., of Berlin, one of several government agencies charged with administering the state's monopoly of foreign trade.

EAST GERMANY'S Type 152 four-jet transport is mounted in a frame for structural test in a structure laboratory adjacent to the main assembly area at Dresden-Klotsche.

Research Agencies

Part and parcel of any country's aircraft industry are the research agencies. Germany has a long tradition of the "institute," a group of scientists, generally with some academic responsibility or connection, who work in the areas of basic or applied research. In East Germany, there are five of these institutes, grouped together at Klotsche near Dresden as the Forschungszentrum der Luftfahrtindustrie (Research Center of the Air Transport Industry). Individual institutes deal with aircraft construction, powerplant development, general technology, equipment, and materials.

This group has a central documentation organization, the Zentralstelle für Literatur und Lehrmittel (ZLL), which publishes research reports, the industry's yearbook, standards, manuals, and a magazine. The ZLL also supplies instructional models of engines or systems, designs and builds training aids, and produces slides and films as visual aids to instruction.

Linked to these institutes through the common goal of research projects are laboratories established within the framework of a specific factory. One example is the Aerodynamics Laboratory of the VEB Flugzeugbau Dresden. The original vertical tail design of the Type 152 transport was built on a flying testbed—type unspecified—and flight-tested by that laboratory to get a comparison between flight and wind-tunnel data.

Incidentally, it has been a long time since such a fundamental aerodynamic design problem as a vertical tail layout has had to be solved on a flying testbed in the West. That particular approach gives one clue as to the state of the aerodynamic and flight-test art in East Germany, and perhaps even in Russia.

The difficulties faced by East Germany in rebuilding the aircraft industry were many and varied and not all of native origin.

First, after World War II nothing was left of the many factories that once turned out powerplants, airframes and equipment for the Luftwaffe. More than 60% of the wartime industry was concentrated in what is now East Germany, including such important installations as the underground V-2 production line at Nordhausen, the Junkers turbojet production plants in Dessau and Berlin, and Peenemünde, with its famed rocket and aircraft development areas.

But American and British bombers combined with Russian artillery and ground forces left very little intact by V-E Day. What was left was systematically looted, wantonly destroyed or physically transplanted by the Russians. Technicians, engineers and scientists fled West or waited for the Russians to catch up with them. Those who waited were considered part of the fixed installations and also physically transplanted.

Second, as a matter of fixed policy, there is no competition within the Communist countries. Division of labor projects is agreed beforehand, and "unanimously" approved by the various governments involved. Thus, Russia handles all research, development and production of military airplanes and missiles, plus the space program, and also heavy transports. Czechoslovakia develops lightplanes, trainers and sailplanes, and has worked on further development of the Ilyushin 14 series, in addition to which it produces military airplanes—notably the MiG-15, -17 and -19 series and the Il-28 bombers. Poland produces sailplanes and sport planes.

East Germany's share is in low-thrust turbojet development and short-range transports. Sailplanes, piston engines and the ubiquitous Il-14P are also produced by East Germany.

These projects create marvelous propaganda opportunities. Spokesmen for the East German aircraft industry can truthfully say that they build only for peace, unlike their Western neighbors. But what they can't and don't say is that they aren't allowed to build anything else, and that—given the chance—they would be off in a minute to build military airplanes and missiles.

Glider Training

Official line is that the East German aircraft industry only started to rebuild in the middle of 1954. But the irrepressible Germans—both East and West—have had a habit of jumping the gun. First tentative steps toward rebuilding were taken, as before, with gliders. A Society for Sport and Technology was formed in 1952 in East Germany to give training, facilities and equipment for what are called "technical sports." The list would include gliding and parachuting, as examples.

Gliding enthusiasts had been combing the ruins of old hangers and factories, and had come up with a few old sailplanes. These were rebuilt, and flown from the old training areas. The wartime gliding schools were reformed, repaired and reopened. New schools for gliding instruction started in Mechlenburg, near Berlin, and in Thuringia and the Harz mountains. One year later production of gliders was in full swing in East Germany.

But powered aircraft had to wait. Work finally started in that area in 1954, almost completely with Russian aid, materials and facilities. While the

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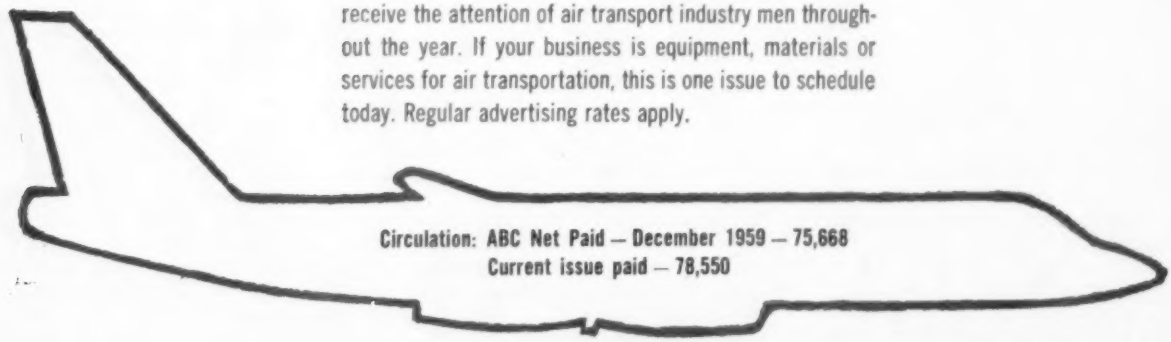

Circulation: ABC Net Paid — December 1959 — 75,668
Current issue paid — 78,550

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Russian contribution is now being soft-pedaled throughout East Germany, there was a time when it seemed impossible for their spokesmen to muster enough praise for what their "big brothers" had done so selflessly.

Most enthusiastic acknowledgement of East Germany's debt to Russia was voiced some months back by Prof. Brunolf Baade, designer of the four-jet Type 152 transport. Baade pointed out that the rebirth of his country's industry and the development of the projects on which they rebuilt their factories and staffs could not have been done ". . . without the help of the Soviet Union."

Baade's comments may have been colored by the fact that he was speaking on the anniversary of Russia's October revolution, a date reserved by speakers all over the Communist bloc for extravagant praise of Russia.

Baade emphasize that the technical cadre forming the nucleus of the reborn aircraft industry was trained in Russia; ". . . hundreds of [East] German scientists, engineers and technicians had the opportunity to work further in this specialized field, collaborating in technical advancement. . . .

"Complete train-loads of highest-value materials, instruments and equipment were sent to us by the Soviet Union . . . a large amount of technical data, experience, special technologies, calculating methods, standards, material specifications, research reports etc. . . . All this the Soviet Union put cost-free at our disposal, whole wagonloads full! Even further, [Russia] has given us the use of scientific institutes for carrying out research and consulting."

Other specific aid mentioned by Baade included shipments of large quantities of aircraft construction materials, license rights for the Il-14 twin-engine transport, use of Russian wind tunnels and other laboratories and materials, instrumentation and equipment for the Type 152.

So out of the rubble of the Third Reich rose the rebuilt aircraft industry of East Germany. The foundations were Russian, but the superstructure was built with local help. Details of factory location and size, numbers of workers or quantity of production are hard to come by, and so it is difficult to make any valid estimate of the overall position of that industry today.

But some facts are available by which to judge both state of the art and the status of production developments:

• **Final assembly area** at VEB Flugzeugwerke Dresden is about 300,000 sq. ft., under a single roof in Hall 22. The area is 557 ft. long, 541 ft. wide and the clear space below the ceiling beams is 88.5 ft. high. Final assembly of the Il-14P has been completed here and the first few Type 152 transports are on the line. About 600 workers were employed during the final assembly of the Ilyushin design; probably more will be used as the Type 152 builds up to peak production.

• **Production of the Russian-designed** Asch 82T engine, now in its seventh modification, was begun in 1956 at VEB Industriewerke Karl-Marx-Stadt. Russians have never revealed figures on the engine life, but non-Russian users have said anything between 200 and 400 hr. was pretty good. German-built engines are getting 700 hr., have been run at 900 hr., and are aiming at the latter figure for the next certification. Power rating of the engine has been increased, although not by such a large margin. Engine is basically a 14-cylinder twin-row 1,900-hp. unit developed from the Pratt & Whitney Twin Wasp.

• **Production of the Ilyushin 14P** began sometime in 1956, and the first complete airplane was shown at the Leipzig Technical Fair in the spring of 1957. No. 50 production airplane rolled out of the shop in October, 1958, and the last of the series came off the line at the end of 1959. Assuming the figure of 100 airplanes is correct, then production could have been at the rate of about three per month, not a very high rate for what is essentially a Convair 240 with Douglas DC-3 performance.

Future Plans

With the phasing out of the Il-14P and the Asch 82T-7 powerplant, the industry is free to concentrate on the Type 152 and the Pirna 014, working on one airplane and one engine at a time. It would be logical to follow this with a smaller transport like the Type 155, still powered by the Pirna 014, and either a trainer or helicopter powered by a Pirna 017 engine, to make up the labor differential between the Type 152 and the Type 155.

Spokesmen for the industry emphasize that they don't want to talk about projects while they are still on paper; they prefer to present data when the airplane has flown. For this reason, they are secretive about future plans.

But they say they would not be doing their jobs if they did not have active project study groups considering every possible type of endeavor for their industry. One spokesman indicated that there were several projects in the transport area currently under study, but he was vague when asked if they were all paper variations of what would eventually be the Type 155 layout.

But the future of the East German aircraft industry will not be one of the industry's own making. They will have to conform to the pattern of non-competitive developments within the Communist bloc, compete for labor with heavy construction and chemical industries, with shipbuilders and transportation.

They will have to develop native technical talent fast, partly because they are losing steadily to the West, and partly because of their mistaken political concept that it is more blessed to work with the hands than with the mind. There are very few high-grade engineers or scientists left in the Eastern area, and those who are there are overworked, responsible to political directives as well as scientific programs, and not able to keep current with developments in any countries outside the Soviet bloc.

This complete lack of touch with the West produces some naive attitudes, such as an engineer from East Germany who asked—seriously—if the West had any jet transports now in service. It also explains such deals as the purchase of three sets of electrical equipment for the Type 155 airplane from English Electric (AW Mar. 14, p. 34). An a.c. aircraft system is still beyond their ken.

The East German attitude also is conditioned by politics, obviously. The industry people feel that theirs is the world's only true industry, singled out because a "farmers' and workers' state only builds for peace." They blame the U.S. and Great Britain for destruction of their country and wartime industry, and conveniently forget that a major portion of the blame rests on Russian shoulders. They speak of the "opportunity" their engineers had to study in Russia after the war, when the only alternate for those engineers was the risk of death.

This political attitude is linked to the rebuilding of the aircraft industry: "We can succeed," say these Germans, "because we have the true mission." Looked at from a viewpoint of cold commercialism, they couldn't stand a chance of competing with the Western manufacturers, selling a transport against the years of experience racked up by Douglas, de Havilland or Sud Aviation.

But because price means nothing when the state has a monopoly of foreign trade, because deals can be arranged to trade airplanes for sugar or coffee beans or long-stapled cotton, and because of the natural loosening of trade barriers the world over, the East Germans may succeed in breaking through the borders imposed on them by their political ideology.

"I don't worry about them as competition in direct selling," said one American engineer. "But they just might get out somewhere and dilute the market and keep us from draining off some of that money. And we can't use any sugar this year."

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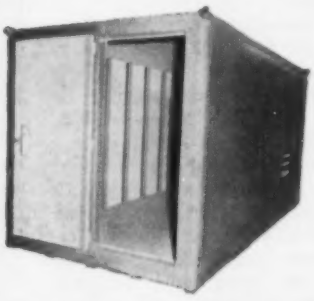
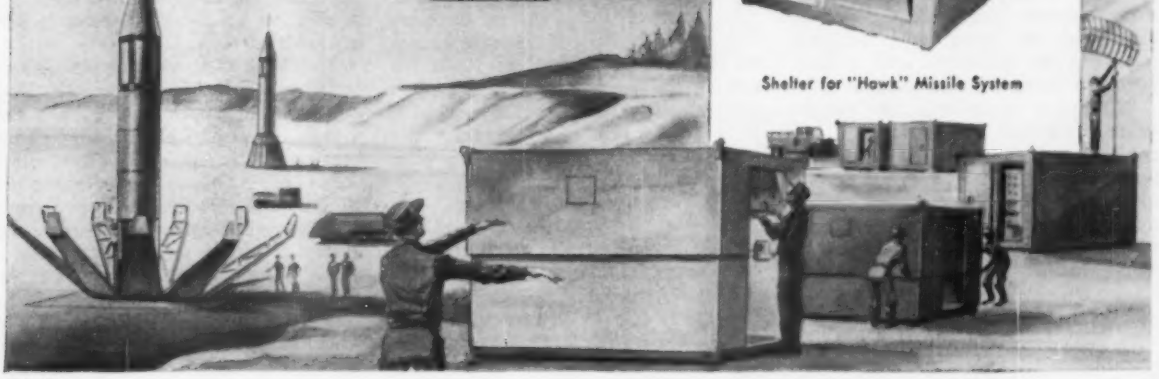


Shelter for "Hawk" Missile System



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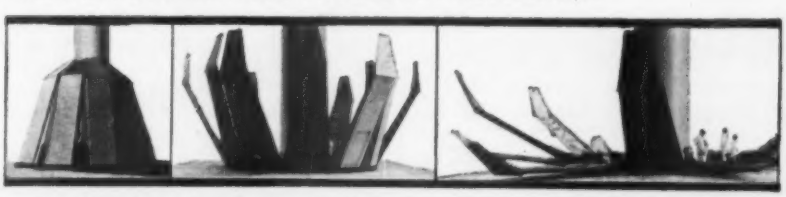

These photos show performance tests on a production model of new tactical shelter for "Jupiter" IRBM.

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Lanphier Details Views on Defense Needs

(Thomas G. Lanphier, Jr., recently resigned as vice president of Convair [AW Feb. 29, p. 27] to begin a public campaign for a stronger national defense program. His first major policy speech was made to the National Press Club in Washington, D. C. Because it is the most comprehensive expression of Mr. Lanphier's views on this subject to date, Aviation Week is publishing the complete text of his remarks.)

As background text for my remarks today, I offer a quote from a fellow Republican and one-time President of the United States: "I wish to point out that the argument now often advanced as to the propriety of criticizing the President, without regard as to whether the criticism is or is not just, has no warrant either in history or on the grounds of public morality." So said Theodore Roosevelt, while he was in the White House.

My comments this noon have to do with the present incumbent of that establishment. I believe President Eisenhower to be an honorable, well-intentioned and amiable man, historically deserving of America's homage for services rendered in other years and other wars. I also believe him to be mortal, fallible and culpable, if he has not competently led us to this point in history. And I do not think he has.

Out of Tempo

Generally, I believe he has listened to the drums of a bygone day—out of tempo with the space age. He has defaulted his responsibility to modernize our organization and our policies for survival and progress in a world swarming with communism.

Specifically, I believe his defense budgets, particularly the last several and culminating in the current one, have been and are based on a dangerous rationale. A rationale I believe the Chief Executive of our government does not have the right to take in this era of push-button delivery of hydrogen bombs, in which an underestimate of the enemy, however slight, could be fatal to our nation's freedom—if not its life.

Before describing what I believe to be the President's rationale, I would like to make a statement of faith in my country. I believe the United States could, if it took appropriate extraordinary action, make it through the sixties unbombed and could maintain throughout some measure of the freedoms we now enjoy.

Further, I believe we could, by the end of this decade, be in a position to move toward the restoration of international sanity in the world. To wit: we could again be strong enough to argue effectively for some measure of arms control.

Meanwhile, I look at the current relative inventory of World War III weaponry, as between communism and what we call the "free world," and I find little encouragement for optimism. We are not armed nor arming ourselves sufficiently nor appropriately for ultra-modern war. I repeat: I think we could, but we are not doing so because of a national self-delusion that, if we keep talking about peace—we must be at peace.

Thomas G. Lanphier, Jr., who recently resigned as vice president and assistant to the president of the Convair Division of General Dynamics Corp. in order to freely challenge Administration defense policies, is a former member of the Air Force Scientific Advisory Board and, from December, 1949, to May, 1950, served as Special Assistant to the Secretary of the Air Force for Research and Development.

Mr. Lanphier, son of a West Point classmate of President Eisenhower, also served as special assistant to Stuart Symington, then chairman of the National Security Resources Board, from May, 1950, to May, 1951, and represented Mr. Symington on the National Security Council senior staff. He resigned from this position to join Convair as assistant to the president, becoming a vice president of the firm in November, 1951.

A former newspaperman and past president of both the National Aeronautics Assn. and Air Force Assn., Mr. Lanphier flew more than 100 combat missions in the South Pacific and another 12 in the European theater as an Air Force pilot in World War II, destroying 7 Japanese aircraft in air-to-air combat and another 10 on the ground. He holds the Navy Cross, Silver Star with cluster, Distinguished Flying Cross with cluster and Air Medal with five clusters.

A graduate of Stanford University, Mr. Lanphier became managing editor of the Idaho Daily Statesman at Boise after leaving the Air Force in 1945. Before the war, he had worked as a reporter for the former San Francisco Daily News.

Actually, World War III has been on, who knows how long? Whether it began over 40 years ago, or during World War II, or with Korea, or Hungary, or with the Sputniks, is a moot point. It is on—and we are losing it. Losing it for many reasons—the principal one: our people and our President don't acknowledge it is being waged against us. We are losing it during the phase we are best equipped to win, and the only one we can win: the deterrent phase.

We have the latent ingenuity and spirit to effectively arm and keep ourselves armed to deter aggression against our allies and ourselves. But we are not doing so.

The opinion I am expressing is not singular with me. There are [illegible] people in the sciences and in the defense industry and in government who agree with me to varying degrees—including the maximum. Not too many feel they can speak out about it. Those who do, experience varied reactions. Outspoken critics in the defense industry are labeled "munitions mongers" and discredited as self-serving. Critics from the Congress are dismissed as partisan.

Critics in uniform, like Gens. Ridgeway, Gavin, Medaris, Taylor, and perhaps, Adm. Carney, find themselves undecorated casualties of a war their fellow-citizens don't even recognize. And officers like LeMay, Hayward, Schriever and Power, while not yet casualties, certainly must be listed among the walking wounded.

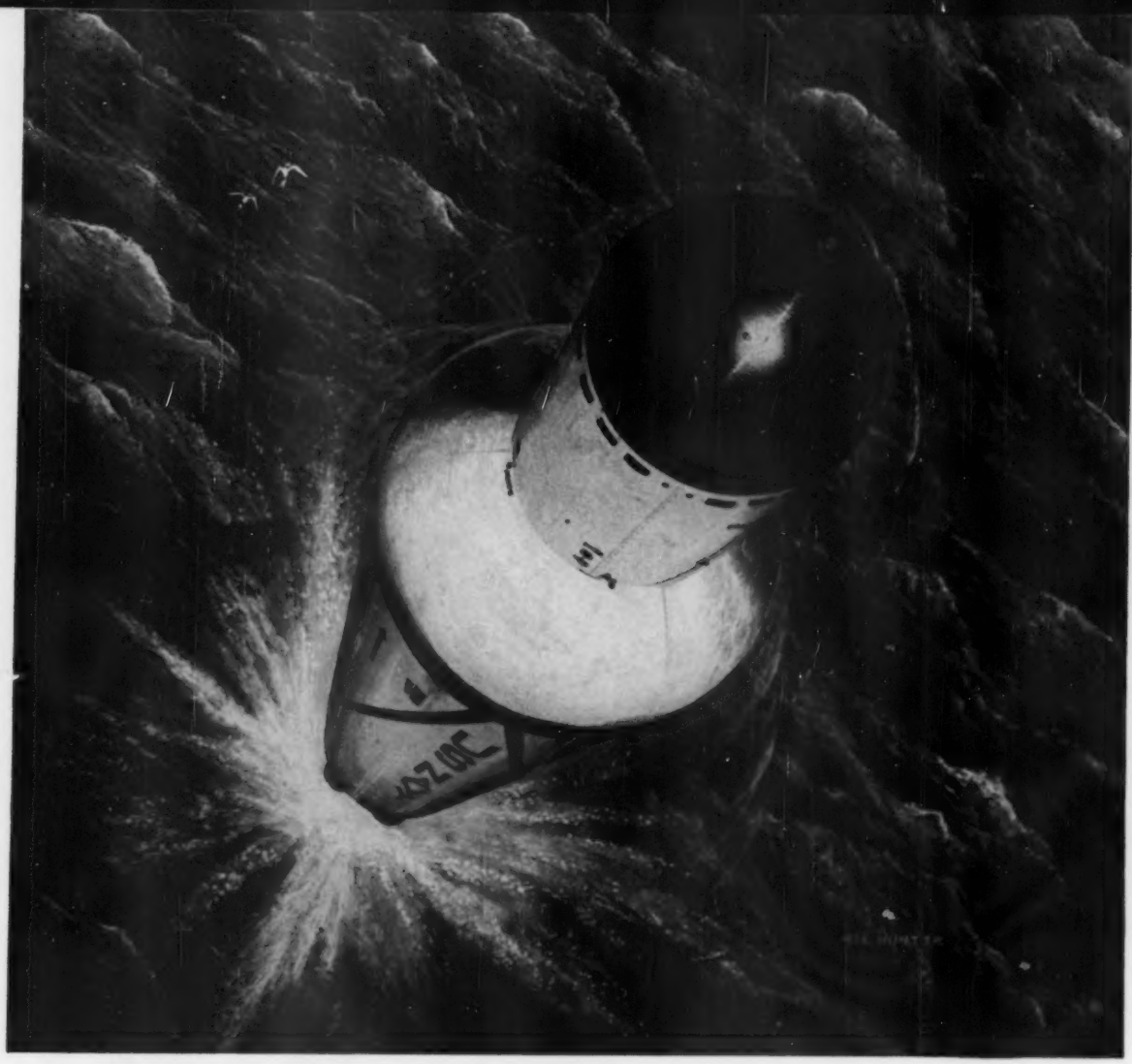
What the form of rejection may be of intramural critics like Robert Lovett, Robert Sprague, Thomas Watson and Dr. James Baxter is not yet apparent.

Incidentally, if men such as these are dismissed as authoritative critics in the defense area, who is to criticize in this area? And to whom does the President look for guidance in this area?

Weapons Revolution

I have said we are not armed, nor arming ourselves appropriately for the war being waged upon us. I believe this is because our people and the Administration have not recognized the revolution in arms which has occurred over the past decade and a half and the concurrent revolution in techniques of warfare as introduced by the Communist ideology.

In this new category of weapons, I would include, in the first instance, a national political philosophy: that is, the attitude of a nation about itself



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and its place in the world of today and tomorrow. In this respect, the USSR has an effective and aggressive attitude toward a clearly understood objective: world domination. In this same category, the United States has, as best I can determine and define it, the "good life" as a somewhat ephemeral national objective.

The second weapon more aggressively used by the Communists than by us: Education. While we appropriately emphasize moral and cultural education of our children, we leave it at that. Meanwhile, the Soviets stress technical and scientific education in fields pertinent to their objective and include, among other things, our language, as well as that of other nations alien to them.

A third weapon: Economics. Here we presume ourselves to be strongly in the combat and probably correctly so. However, here again, communism selects the economic fronts it considers pertinent to its objective, then puts up at least an impressive facade in these selected areas.

The fourth weapon: Propaganda. Ironically, on this front we, the greatest advertising nation in the world, are time and again beaten in the contest for the world's attention and respect. The Communists shrewdly and deliberately advertise their technological accomplishments in space and elsewhere. And they brandish their missiles and other forces in consonance with their political programs and objectives.

A fifth category of weapons, and one which the President specifically rejects as such: Outer Space. Publicly contradicted though he has been by his propaganda expert, Mr. Allen, and his chief scientific adviser, Dr. Kistiakowsky, the President continues to read us out of the competition in this great new frontier, and allows our military and non-military efforts in this field to drift along, formally unintegrated.

The final category of World War III weaponry: The physical military weapon systems: Hydrogen-bomb-carrying ICBMs, manned bombers and submarines, and systems for defending against them, to the extent there can be such systems. Also, the more conventional (though with ingenuity, they need not be so) forces needed to deter limited aggression.

In the face of communism's vigorous exercise of weapons on all these World War III fronts, we must excel at least in this last category—if we are to survive. And we must, over the long pull, excel in all the others. However, if we do not stay physically strong this year and next, we do not stay alive and free enough to prosecute the contests on the other fronts. It is therefore in this category of physical weaponry that I would lodge my specific criticisms today.

Atlas-Able V

Cape Canaveral, Fla.—Atlas-Able V lunar orbiter probe, which National Aeronautics and Space Administration plans to launch this summer, will be similar to the Atlas-Able IV payload, but it will not have a television-type scanning system.

Television system, which was to have scanned the lunar surface as the Atlas-Able IV probe orbited the moon, has been excluded from the Able V payload, apparently because of the relatively poor quality of the picture it could reproduce. Stanford University VLF radio wave propagation experiment also has been withdrawn from the program, and a plasma sensor has been added that will measure low energy particles.

NASA has ordered two Atlas-Able launch vehicles similar to the vehicle which failed in its attempt to launch the lunar orbiter probe last November (AW Dec. 7, p. 31). They will be equipped with identical payloads, with the second serving as a backup for the first launch attempt. Should the first launch be successful, the agency may decide to vary the experiments in the second payload to return a wider variety of data from the two flights.

Judging from his budgetary inattention to them, the President does not realize that the United States must maintain a viable strength in three categories of physical weaponry, each equally important over the long haul, and each overlapping the other to some degree.

These categories are: An invulnerable deterrent against massive attack, a limited war deterrent and a home guard.

Deterrent Capability

As to the status of an invulnerable deterrent—our deterrent is indeed, as the President has described it "incalculably powerful" but it is not invulnerable. It concurrently consists of less than 100 static aiming points for an enemy equipped with ballistic missiles fired either from Russia or from off-coast submarines.

Such bombs as we have available for retaliation are chiefly lodged in land-based manned bombers standing on less than 100 SAC bases here and abroad.

We have no warning of missile attack from Russia and will not effectively have for several years. We have no active defense against missile attack from submarines or from Russia, and will not have for many years, if ever.

We do not yet have our own ICBMs as a significant part of our deterrent. The Atlas, while testing out satisfactorily, is not currently planned in significant operational numbers and deployment for another two years. Our entire ICBM force now in operation affords only one soft aiming point to the enemy.

The Titan, which is just beginning to prove its quality, is even farther than the year or so beyond the Atlas that the Administration has indicated it will be.

Mobile ICBMs—the Polaris and the Minuteman—are highly desirable when they are finally available, but are limited in performance even then and will remain limited as long as we continue to restrict ourselves from underground testing.

These mobile systems will not, by the way, be operational at the early dates advertised for them. For instance, to say that the Polaris weapon system complete with submarine, crew, missiles and assigned target will be operational this year, barely four years after acceleration —is well known to Soviet and American missile professionals to be optimistic by at least two years. The Atlas, for instance, is now in its sixth year of acceleration and is just becoming qualitatively operational—as originally scheduled on the highest priority in 1954.

As to our limited war capability, it is useful only in non-combative situations, such as Lebanon.

Even including NATO, we could not and cannot handle a Berlin on a localized basis, as President Eisenhower himself acknowledged last spring. You will recall he allowed we could not match possible aggression by East Germany with conventional forces. When asked what we might do with the big bombs, he observed: "We will face that when we come to it." As I understood him, he left us with two alternatives: Capitulation or national suicide. And I doubt many of you would disagree with him, at least in the current climate of our national attitude, if he chooses not to exchange nuclear weapons with the Russians over Berlin.

In this regard, the current budget reflects presidential culpability in not including significant funding for airlift and for the initial development of devices which could be afforded the Army and Marines to render them effectively deterrent in a limited war situation against the Communist hordes.

As a result, the President goes to Paris in June even weaker, in an armed sense, than he was before Khrushchev lifted his ultimatum over Berlin last spring. He could warn Khrushchev that an incident involving Berlin would cause us to arm for limited wars beyond Berlin. But Khrushchev, noting how quickly this same Administration minimized our limited war strength after cessation of the Korean war, might not be too impressed with this argument.

As to our home guard—we have nothing. No national program for fallout shelters. No program for converting our farm surpluses to a significant element of the deterrent; a World War III

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Saab J35A Draken Joins in Swedish Defense Exercise

Swedish Saab J35A Draken double-delta jet interceptor (AW Feb. 1, p. 50) takes off during a three-day air defense exercise over central Sweden, involving 250 planes. The Draken carries two Sidewinder infrared air-to-air homing missiles, mounted on the belly. One complete unit, the F13 Wing at Norrkoping, has been equipped with J35As.

weapon the Soviets do not have, by the way.

The governor of New York appears to be the only executive of high standing in the nation with principle and guts enough to press this issue in his own bailiwick. It is ironic that Governor Rockefeller, with much to lose politically, does push the civilian shelter program; while President Eisenhower, with nothing to lose, does not.

We are not sufficiently armed in any one of these categories; an invulnerable deterrent, a limited war deterrent or a home guard—let alone all three.

The fault for this lies basically with all of us. Yet the person who represents us, and who is responsible to us for our defense, is the President. Over the past years, with the best intentions in the world, he has led us incompetently to a point where we are in jeopardy of our national life.

He has done this by not recognizing that we were in World War III. Hence, he has put budget-balancing above all and, as a result, "business as usual" is the watchword in our land. And business is pretty good.

Parenthetically, we did not worry about balancing our budget during World War II yet we are considerably worse off now than we were then, in terms of a direct threat to our homes and families and freedoms.

From this attitude—balance the budget! We are at peace!—has stemmed a series of rationales, all of which are dangerous.

We have consistently tended to base our estimates of the enemy's missile and space efforts on our own peacetime rate of effort or less, with resultant intelligence estimates far lower than hard-headed logic should give the enemy.

For instance, Secretary McElroy said last winter our government estimated the Soviets would this year, and for the next two years, have only three times as many ICBMs as we planned to have within that same period. In so doing, he downgraded Soviet production and operational training capabilities to a degree startling to any professional in the missile business.

Since were were scheduled to have and will actually have, only a handful of ICBMs operational this year, Mr. McElroy implied that Russia would only have three handfuls by this same time. It is more likely their lead in ICBMs this year is several times a ratio of three to one. It could well exceed the 150 ICBMs Gen. Power has conservatively estimated is all they need to wipe out SAC.

For instance, had the United States fired the Sputniks two and one half years ago, we could today have at least 250 ICBMs (working six days as the Russians do) out of one plant—and 400, if we had used two plants.

Another dangerous rationale: Secretary Gates a few weeks ago publicly testified before the House Appropriations Committee that our intelligence experts include in their assessment of Soviet missile capability a guidance efficiency inferior to ours. Neither Secretary Gates nor any technical adviser to him can factually substantiate the assumption that the Soviets, who are years ahead of us in space and allied ICBM weaponry, are inferior in the accuracy with which they can fire their intercontinental ballistic missiles. To use this assumption as one of the factors in assessing the number of missiles the enemy must have to pose a significant threat against our less-than-100 SAC aiming points, is critically dangerous to our national defense.

The mathematics of the matter are known to the Soviets, as well as to anyone in our missile business. For instance, if you give the USSR credit for even one mile worse error in guidance than the two miles the President has publicly given us, you increase your estimate of the number of missiles Russia needs to destroy ours at least twice. If you give the Russians one mile error instead of three, the difference is eight times.

Areas in which the President has defaulted his organizational responsibility are: The unification of the services for which he used to argue, and which is urgently required if time, money and, perhaps, our way of life is to be saved.

Our intelligence, sketchy at best, is not affirmatively used by our defense planners except on an opportunely spot basis such as I've just outlined regarding Soviet ICBMs. Our defense budget is not formally planned against the over-all estimated threat officially ac-

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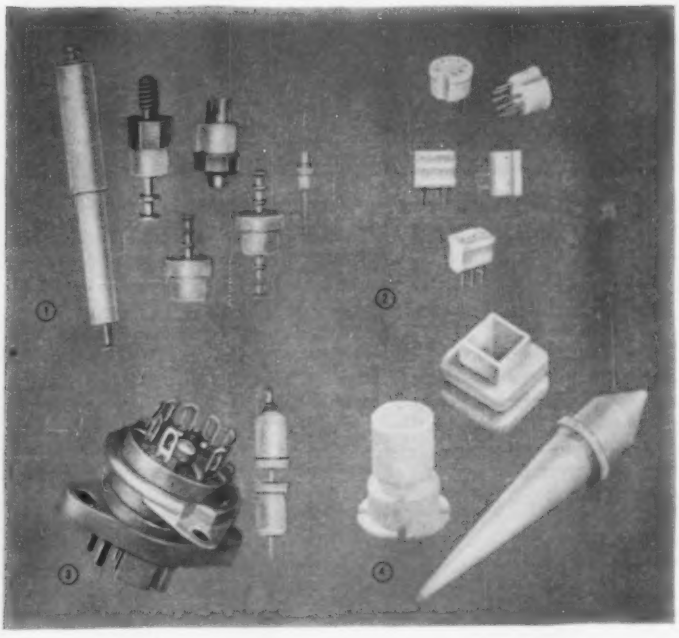

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knowledged at the time the budget is being formulated.

As a matter of fact, the size and general shape of our defense budget is currently not primarily determined by the Joint Chiefs of Staff, but by the Bureau of the Budget. However, in playing its intrusive role in the development of our defense budget, the Bureau of the Budget has at least introduced an appropriate functional approach to the problem, something the Joint Chiefs of Staff have not yet been able to do.

As budget director Maurice Stans has testified: "Without balancing any dollars in the budget, we grouped together the program components of each of the four services into four categories. One was the strategic striking forces; the second was the defense of the striking force and the home base; the third was the ground and sea forces and the fourth was the general category of support to the forces."

For this approach, credit is due Mr. Stans but no credit is due President Eisenhower for letting the wrong element of the government dominate the shape and size of our defense forces of tomorrow.

Qualitative development in defense, largely engendered in science and industry, is encumbered by peacetime regulations and restrictions, and is largely in the dark as to the progress and problems encountered by the enemy and known to our intelligence. It would save time and money in development of our own ICBMs, for instance, if we knew what troubles and successes Russian missile makers are having.

Further, the President has allowed our nation to drift, for lack of a national policy clearly understood by our own people, our allies and our enemies, almost to the point of no return from extinction.

The only policy articulated by his Administration to date, that of massive retaliation, was born in an era when we alone held the nuclear power and implied we would visit punishment with A-bombs for large or small aggressions.

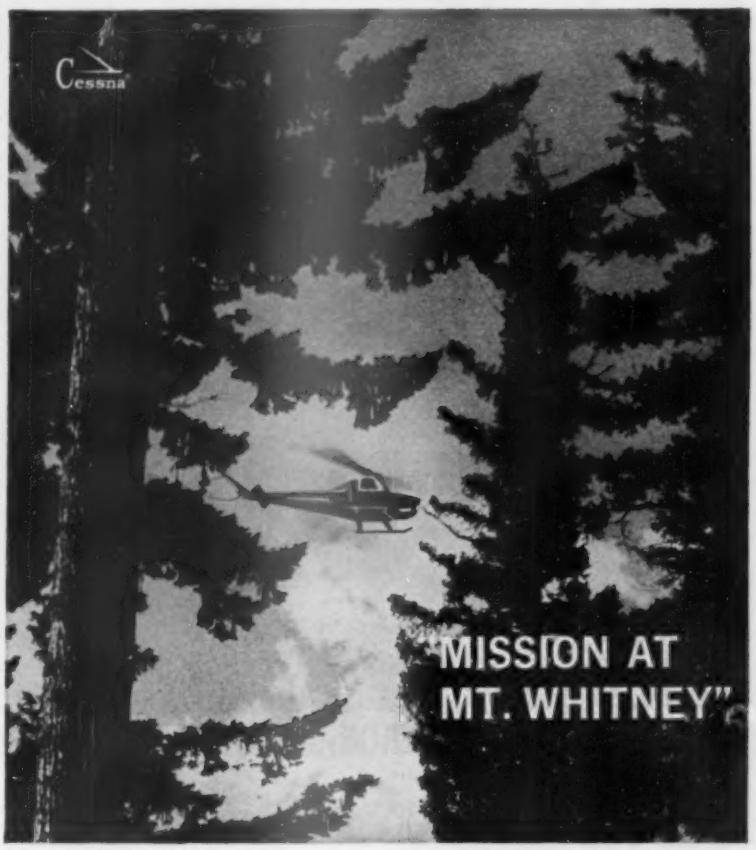
Over the years, this policy has not helped the Hungarians, or Indo-China or Tibet. And it did not deter Khrushchev from delivering his ultimatum to the United States the winter before last. I think the fact that Khrushchev dared offer the ultimatum—the first in the history of this country—is of a significance overlooked by this Administration in its assessment of the efficacy of our own deterrent.

Our massive retaliation policy, unsupported by a limited war force at least equal to that of the East Germans, will probably not indefinitely deter Khrushchev from handing the gauntlet of Berlin over to East Germany.

And if Khrushchev does hand the situation over to the East Germans, and they do move on our garrison in Berlin, are you prepared, as one of millions of Americans who must answer the question sooner or later; are you prepared to die in a nuclear exchange over the principles involved there? I wonder. And so do millions of Europeans. And so probably does Khrushchev.

As to the matter of national suicide in an exchange of nuclear weapons, who is really in jeopardy? We certainly are, with our concentrated population, our lack of fallout shelters, our lack of warning of missile attack. The Russians probably do not consider themselves so, since they have long had a civilian defense program and will have alerted their people, in their own defense by the very fact of their own aggression plus the fact they are amorally prepared to accept the loss of millions of lives to achieve a political objective.

In the past 20 min. or so, I have presumed to criticize President Eisenhower's administration of our government. I don't do it lightly or without having given it long and troubled thought. And, again, I don't think the situation is hopeless. There are things our nation can do to better ensure our chances against blackmail or death over the next three years—and a resumption of a status of power parity later in the decade. Some of them cost money and



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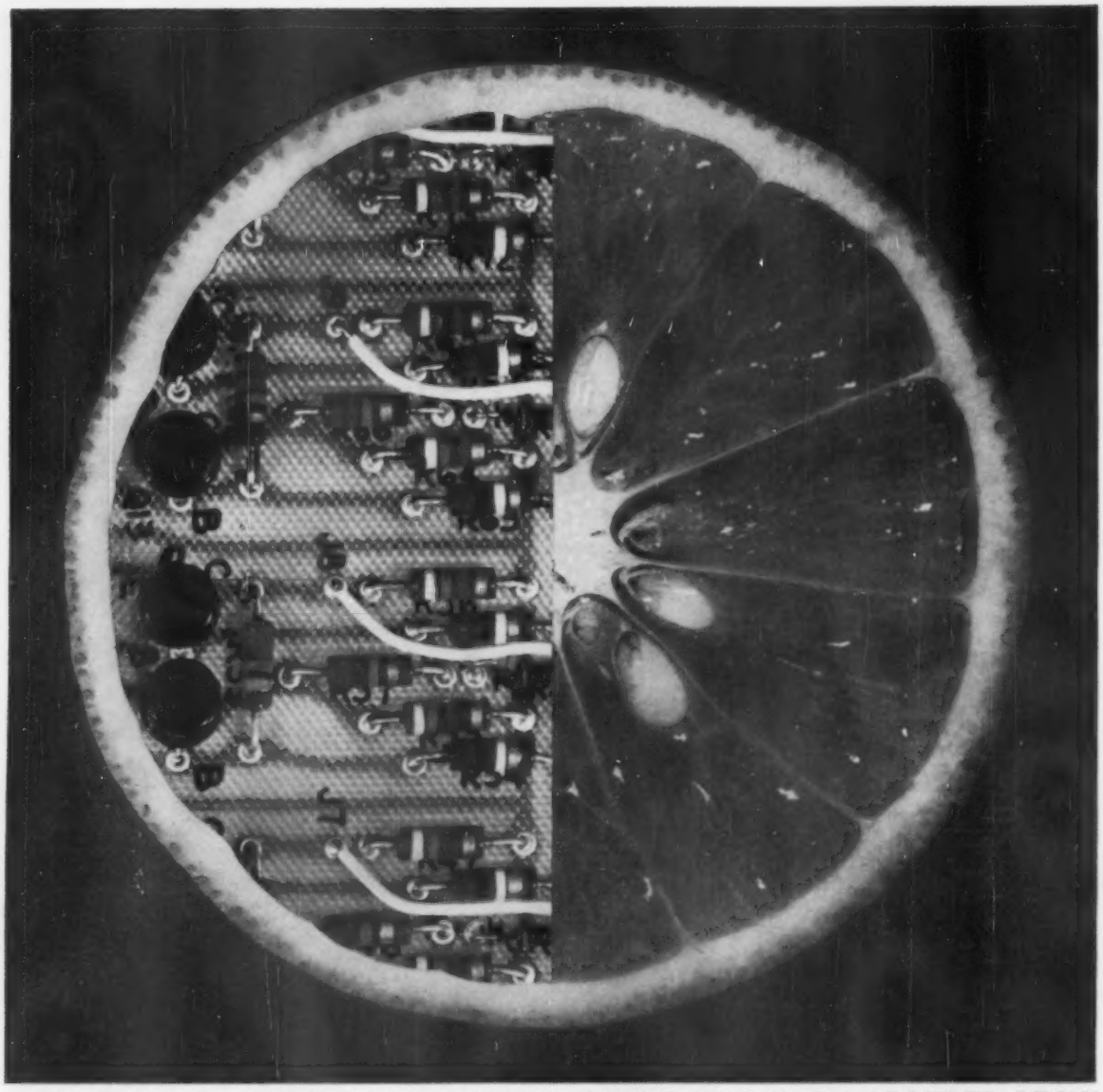

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they'll involve overtime effort, and the abandonment of many a tradition and entrenched personal position. But if they're done, I think we can make it.

They are such actions as protecting and improving the deterrent by:

• **Getting a quarter of the Strategic Air** Command airborne and keeping it there for at least the next three years and buying the additional KC-135 tankers, B-52s and B-58s needed to maintain the alert.

• **Adding 100 Atlas underground** aiming points by mid-1963 thus increasing the requirement upon the enemy for ballistic missiles at that time on the order of 1,000.

• **Adding 20 Titan points** in the ground by mid-1963, increasing the enemy's missile requirement by another 200.

• **Accelerating Polaris and Minuteman** mobile ballistic missile systems toward an objective of having them effectively operational in significant numbers by 1963-1964.

• **Resuming testing underground** in order to increase the capability of the mobile ICBM systems—and add to our limited war deterrent.

• **Accelerating the missile-warning** satellites, Midas and Samos.

• **Beginning serious development** of an anti-submarine warfare system.

• **Prosecuting a sensible** anti-ballistic missile system—most likely from space.

• **Funding a modern and sufficient** airlift for the Army and Marines.

• **Prosecuting the development** of nuclear propulsion for our space systems. This is our one major opportunity to catch and surpass Russia in space over the next 10 to 15 years.

• **Prosecuting the development** of nuclear propulsion for aircraft and the B-70 as a development for penetrating the thermal barrier.

To minimize waste of talents and funds:

• **Cancel the Bomarc** anti-aircraft missile system entirely. It is obsolete. Use some of the money thus saved to buy autonomous manned interceptors—the Soviet manned bomber threat is still also with us for some years to come.

• **Cancel the Nike Zeus** anti-ballistic missile system as too expensive for the limited capability it could afford.

• **Cancel the nuclear carrier** as unjustifiable, by any weapon system analysis, for inclusion in either the massive or limited war deterrent.

Unify the services with one promotion list and create:

• **An integrated retaliatory force.**

• **An integrated limited war deterrent** force.

• **An integrated home defense** against submarine and air attack.

• **An integrated logistic force** to support the foregoing.

Require the JCS, not the Bureau of the Budget, to build defense budgets on a functional basis, related to the estimated threat.

Keep the Congress, as well as the executive branch, periodically advised of the estimated threat. And present the threat in a form relative to the problem of building a defense against it.

Unify the space effort and give both the military and non-military national efforts in space their appropriate emphasis by appointing a space-czar at the National Security Council level, to be responsible directly to the President.

Inaugurate a civil defense home guard with shelters, food supplies and small arms; and finally:

Establish and vigorously maintain a government agency for the long-term purpose of planning arms control—toward that happy day when we may again be strong enough to be taken seriously on the matter.

Meanwhile, most important of all—our national attitude. I suggest reconsideration of "peace and prosperity" as the watchword of our day. And urge, instead, something along the lines of "sacrifice and survival."

For I am sure "the good life" is not enough. In this crisis, dignified survival and progress will be earned only by the vigilant, the active, the brave.

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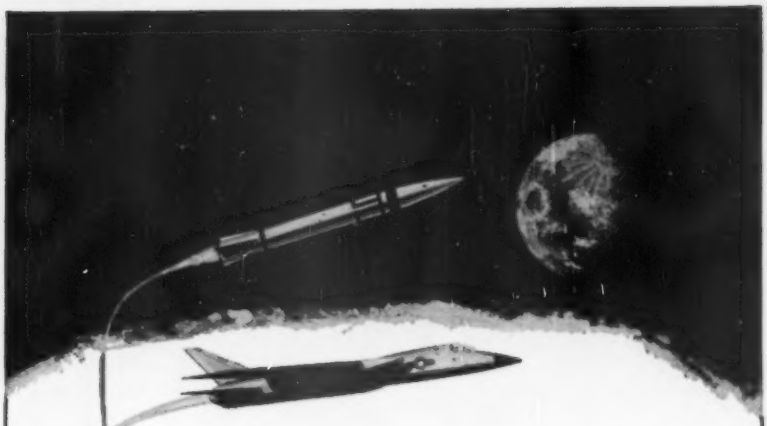

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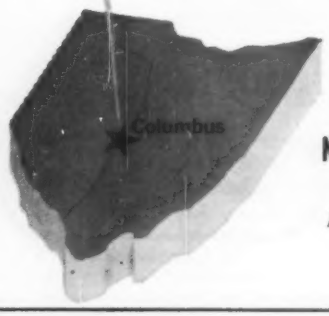

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WHO'S WHERE

(Continued from page 23)

Changes

W. A. Kerr, manager of the newly established Military Products Division, Bausch & Lomb Optical Co., Rochester, N. Y.

Rex E. Moule, chief of basic design, Hamilton Standard, a division of United Aircraft Corp., Windsor Locks, Conn. Also: **Alfred B. Thacher,** manager of sales engineering.

Justin L. Bloom, project engineer for advanced SNAP (Systems for Nuclear Auxiliary Power) programs, Nuclear Division, The Martin Co., Baltimore, Md. Also: **Robert W. Cuthill,** chief engineer, The Martin Co.'s Orlando (Fla.) Division.

Dimitrius Gerdan, manager-aircraft engines operations, Allison Division of General Motors Corp., Indianapolis, Ind. **James E. Knott** succeeds Mr. Gerdan as director of engineering.

Robert P. Brush, assistant director of international commercial sales, Douglas Aircraft Company, Inc., Santa Monica, Calif.

The Advanced Projects Laboratories of Hughes Aircraft Co., Culver City, Calif., has made the following appointments: **Dr. Fred P. Adler,** director; **Dr. Leonard Gross,** assistant director; **Dr. Renne S. Julian,** technical director.

F. E. Rushlow, manager-sales and contract management, General Electric Co.'s Missile and Space Vehicle Department, Philadelphia, Pa.

Chester L. Meador, director of contracts, Convair Division of General Dynamics Corp., San Diego, Calif.

Harold W. Giesecke, manager-electronics department, Hydro-Aire Co., Burbank, Calif., a division of Crane Co. Also: **Cecil Young,** engineering manager for electro-mechanical equipment.

Paul J. Larsen, director of government relations, Allen B. Du Mont Laboratories, Inc., with headquarters in Washington, D. C.

W. J. Wiley, manager-missile manufacturing, Aerojet-General Corp., Downey, Calif.

Nathaniel Hughes, military market analyst, The W. L. Maxson Corp., New York, N. Y.

John W. Brazil, director of industrial mobilization planning, Raytheon Co., Waltham, Mass. Also: **Ashley A. Farrar,** director-government contracts.

Charles R. Glaviano, manager-Rome, N. Y., office, Hoffman Electronics Corp.'s Military Products Division.

James A. Gibson, manager-communication and navigation systems engineering, General Electric Co.'s Light Military Electronics Department, Utica, N. Y.

Allison E. Gossett, director of aviation sales, and **Donald R. Jahn,** aviation sales merchandising manager, AC Spark Plug Division of General Motors Corp., Flint, Mich.

Robert G. Melrose, director of sales-advanced systems and research, Republic Aviation Corp., Farmingdale, N. Y. **Carl F. Damberg** succeeds Mr. Melrose as general manager of Republic's Missile Systems Division.

John A. Swint, director of operations, Ogden (Utah) Division of The Marquardt Corp.

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Engineering-construction firm engaged in nation-wide industrial projects needs co-pilot-mechanic on E18S Beechcraft. Will be based in Pittsburgh, location of home office. Applicant should hold a commercial license and A & P license. Instrument rating desirable. Should have 500 hrs. flying time. Reply to: Buell Whitehill, Jr., Director of Personnel, The Rust Engineering Company, 930 Fort Duquesne Blvd., Pittsburgh 22, Pa.

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Senior Military Pilot. 33. 4000 hours total. 1600 single and multi engine jet, scheduled airline experience, domestic. Qualified Aircraft Maint. Officer, 2 years Director Maint Training. Staff level. F.A.A. Commercial S&MEL. Flight Instructor, Aircraft and Instrument, ATPR written passed, current 1st class medical. College background. Resigning of own volition. Desire responsible competitive position. PW-4177, Aviation Week.

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P-4179, Aviation Week
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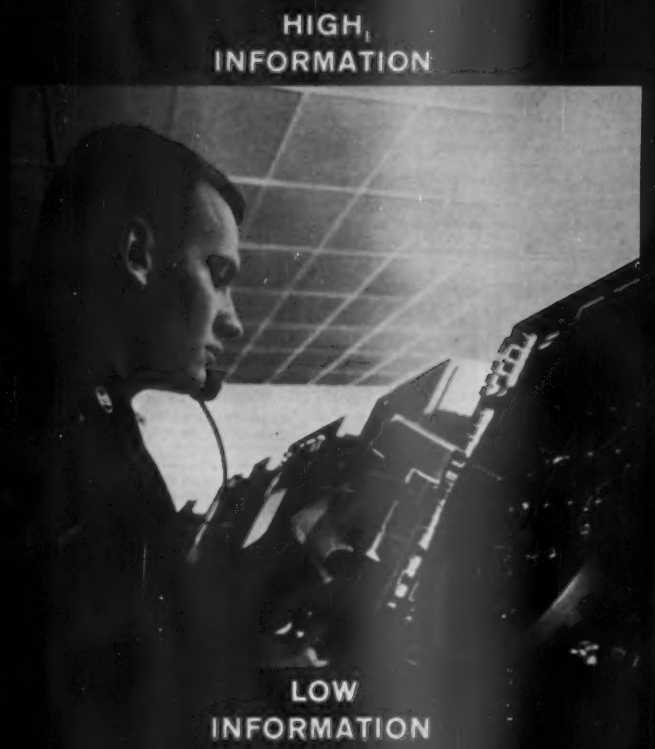

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The operator shown above is on duty at the radar display console of an air defense system.

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John, a Computer Engineer, is twice as old as his wife was when he was as old as his wife is now. He is 24. How old is his wife?

—of ancient origin

Let us not to the marriage of true minds admit impediment, as Shakespeare said. How about getting yours and ours together if you are interested in digital display, video, and deflection circuit design for CRT display consoles. Our unique projects in this area require scientists and engineers with unfettered minds. Write to Mr. Ron McNiven.

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LETTERS

FAA Leadership

The unique hodge-podge of noble objectives, sound reasoning, partial facts, biased observations and inaccurate deductions entitled "Perspective on Safety" (AW Feb. 8, p. 21) must have been written while you were standing on your head blindfolded. That Congress has finally recognized our country's aviation problem and allocated needed funds; that the FAA represents a sound step in the development of a proper regulatory agency; and that General "Pete," having finished a few overdue projects, is flexing his muscles for all to see, is well and good. However, all of this activity has not succeeded in averting one of the worst safety records in the history of commercial aviation.

It should be dawning on you that perhaps the General alone is not the "priceless ingredient" in this case. The FAA needs leadership, not drivership, wisdom as well as knowledge, patience along with vigor, accuracy as well as force, justice with enforcement, and an understanding of people as well as things. We need a leader who can knit the various industry groups into a team with one common objective, instead of tearing them further apart. The formula of dedication, speed, muscle and guts that the General has used so far obviously will not get the job done.

After reading your editorial I find it difficult to decide which is the worst: special interest groups trying to impress their dues payers with Washington headlines, inept public servants trying to "bull" their way through a difficult situation, or careless writers allowing themselves to sink dangerously close to editorial dereliction by failing to seek out all the facts before attempting to influence public opinion. Before you flip completely into the role of personal press agent for the General, let me suggest that you examine closely the underlying factors which make up the impressive statistics the General has been tossing around Washington. Examine the mitigating circumstances and less ominous connotations of his hackneyed handful of horrible examples of "willful violations" of law and order he has so carefully selected from the nearly 50,000 daily airline pilot flying hours. Read the long list of existing "whitewash" regulations designed to protect government officials when public heat is on during the cyclic periods of air crashes and see if you can figure out how their indiscriminate enforcement will improve air safety. If you want to kick over a "bucket of worms" and uncover a hilarious paradox, check with some of the pilots who have had to fly with the General in recent years and see what kind of a reputation he has as a respecter of Civil Air Regulations. Instead of condemning the "monotonous criticism" of this cowboy turned lawman, and the "shrill and monotonous tirades of special interest pleaders," take the trouble to find out what is behind them and how this may influence public welfare.

The FAA with its broad sweeping power and lack of appeal from errors and/or injustices it may create is no place for incompetence, pettiness, flamboyancy, personal aggrandizement, or political ambition. Perhaps it is time you put its administration under a lens, rather than an entire industry which, by any yardstick, has a remarkable record of both growth and safety achievement.

D. W. Richwine
Airline Captain
Prairie Village, Kan.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Bombs on Airlines

Your Letters to the Editor page has been filled with suggestions for detecting the presence of bombs on commercial aircraft. Many of the ideas offered have been very interesting, but for one reason or other not an ideal solution. I have not noticed my own pet scheme in print, so here goes.

Let's require all manufacturers of explosives to add a radioactive tracer to their formulas. Very simple equipment could be used to detect the presence of a tracer when loading an airplane. Only a small number of parcels would then have to be examined more carefully.

I assume that the small amount of radioactive tracer could be added economically by the explosives manufacturer. Possibly the presence of the tracer in explosives will have other useful applications, making it easier to persuade the manufacturers to go along with the idea. If the idea is a good one, world-wide adoption would be possible. After present inventories of explosives have been used up airline passengers and their insurance companies would be relieved of present anxieties.

John W. Peterson
Ann Arbor, Mich.

Many proposals have been made for providing a check on the sabotage of airliners due to bombings. Most proposals suggest the inspection of passengers and/or baggage through the medium of X-ray, fluoroscope, or visually. Most fantastic measure proposed is to screen out known criminals; this is to be done by computing machines checking passenger lists. Another proposed deterrent is to emphasize the efficiency of aircraft accident investigators in detecting sabotage and exposing the offenders to society. The most recent proposal suggests tagging explosives with radioactive isotopes. However, I propose the most effective weapon for the prevention of future sabotage would be to eliminate the incentive—namely, the insurance payoff.

The bomber's preference for an airliner in lieu of other means is the happy thought of monetary gains through insurance. This motivating factor could be eliminated by:

1. Removal of trip insurance vending machines that are abundant at air terminals.
2. Control underwriters' writing of specific flight coverage policies.

Undoubtedly, strong measures will have to be taken to force the insurance companies from this lucrative field. However, until flight coverage insurance is eliminated, every crackpot will continue dreaming of sending himself, mother, or best friend to eternity via the green insurance payoff airliner route.

R. Pete O'Donnell
Amityville, N. Y.

Accident Chart

After reviewing several reports relating the fines that both flight and ground crews have been paying for oversights leading or contributing to accidents, I somehow feel that someone is not being treated fairly. I would like to present an idea that may prove in the long run to be more effective in solving the problem of improper personnel performance deemed to be contributing to aircraft accidents.

Basically, my suggestion would be to keep a running log in chart form of all airline operators and denote personnel and equipment infractions or failures as they occur, using a scaled designation to depict the severity of aircraft damage resulting. Such a chart could be periodically reviewed, weighing the infractions against the flight times of each airline and compiling a listing of airline accident rates. Using such a list, those airlines operating with the lowest accident rates could be rewarded by allowing them preferred, or requested, routes in favor of those airlines which have higher accident rates. (Some other form of reward could certainly be used if this proves inappropriate.)

The ultimate purpose of gaining accident-free flying would be approached, in that the airline management would itself be penalized if their accident rate were not good. They, in turn, would take measures to improve their record, and would naturally start at the working level. If they determined that a particular individual was continually at fault, the company's remedy might eventually be to dismiss or relocate that individual (which would be more or less the same effect as fining him from time to time). If the airline found that several employes were contributing to its poor record, it might then determine that the company training program was insufficient and take corrective action there. In either case, the problem would be put in management's lap where the solution would best be resolved.

By this approach, the singularness of individual penalizing would be prevented, this saving individual embarrassment and loss of money for what conceivably could be a case of circumstance. On the other hand, if a particular person is accident prone, he will soon be discovered and a much better cure, that of removing the problem, might be brought about than by depriving him of what he thinks is well-earned money.

Roald N. Eide
Castle Creek Road
Binghamton, N. Y.

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THE HUMPERDINK HORNET, FIRST ATTEMPT AT A HIGH ALTITUDE INTERCEPTOR PROVED A DISMAL FAILURE DUE TO THE NECESSITY OF KEEPING ITS PILOT WARMLY DRESSED. LIFT RATIO WAS POOR, AIRCRAFT WOULD NOT BECOME AIRBORN. (TAXIED WELL).
FIRST KNOWN EVENT OF ARMED-COMBAT COULD APPROPRIATELY BE TITLED "RUDGE-WHITTLEBY'S REVENGE." IN OCT., 1914, OVER ST. OMER, RUDGE-WHITTLEBY'S MACHINE, ON ROUTINE RECONNAISSANCE, WAS ACCOSTED BY THE FRITZ-HEIR GRAF VON SCHMALTZ. KRUMPLER," WHO THEN DID CRAP WITH A BOTTLE (EMPTY) OF INFERIOR SCHNAPPS, CAUSING MISHAP TO THE BRITISH MACHINE." RUDGE-WHITTLEBY'S REVENGE CAME IN THE LATE SPRING, WHEN HE "SEVERELY DAMAGED VON SCHMALTZ' KRUMPLER WITH A LARGE GRANITE ROCK."
BERSERAC'S FLYING FIELD GUN FLEW QUITE WELL FOR A CANNON, BUT DUE TO HEAVY VIBRATION ACCURACY IN FIRING WAS NOT POSSIBLE IN FLIGHT.
THE PHRASE "LOST IN THE RIGGING" BECAME ALMOST AS FAMILIAR AS "LOST IN COMBAT," PARTICULARLY IF THE AIRMAN WAS UNLUCKY ENOUGH TO BE ASSIGNED TO A "STUDLEY SPARROW," AN AIRCRAFT EASILY RECOGNIZED BY ITS ABUNDANCE OF STRUTS, WIRES, AND BRACES.
THE SAME APPLIES TO THIS EARLY WESTPHALIAN-FRISIAN FLYING BOAT, OF WHICH THERE WERE ONLY TWO MADE.
TATSUKI NYTAKAWA, ORIENTAL AIR ACE, ENCOUNTERED SERIOUS EXHAUST PROBLEMS WHILE TAXIING THE BANZAI B-7. FURTHER RESEARCH REVEALED PROBLEM WAS DUE IN PART TO FAULTY FUEL MIXTURE, FOR SAKI DOES NOT MIX WELL WITH LIQUID PETROLEUM
COLIN BAILEY

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